SCIENTIFIC AMERICAN SUPPLEMENT. No. 1222

Scientific American, established 1845.
Scientific American Supplement. Vol. XLVII. No. 1222.

NEW YORK, JUNE 3, 1899.

Scientific American Supplement. $5 a year.
Scientific American and Supplement. $7 a year.

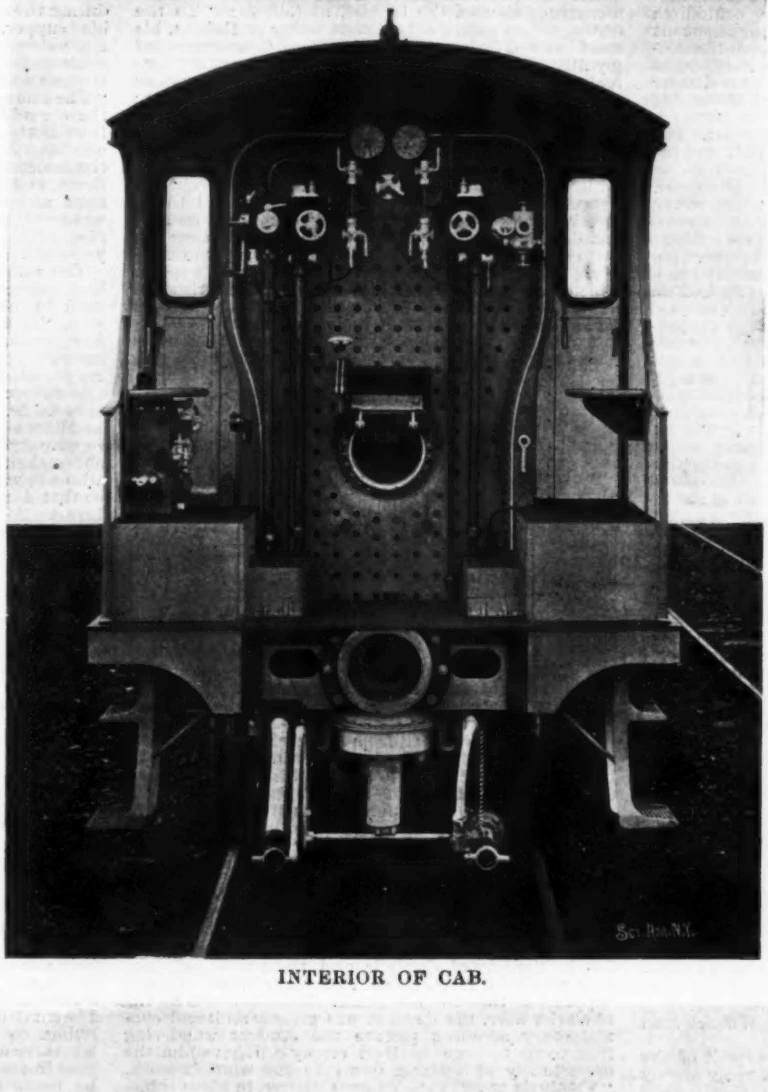
THE LATEST AND LARGEST ENGLISH EXPRESS LOCOMOTIVE.

In the extremely powerful express locomotive of which we present illustrations, the English engineers have made a radical departure from their usual practice, particularly in the exceptional size of the boiler and the great height at which it is carried above the rails. Looked at with American eyes, English locomotives have appeared to be lacking in the important element of boiler capacity. One can to-day, indeed, find upon different English roads locomotives with cylinders of 18 inch diameter by 24 inch stroke, whose boilers do not possess more than 1,000 square feet of heating surface; and the celebrated single-wheelers of Mr. Stirling on the Great Northern Railroad, whose cylinders are 18 inches diameter by 28 inches stroke, as originally built, did not boast of more than 1,100 square feet of heating surface. Of late years the demand for more powerful engines, arising from the ever-increasing weight of the rolling stock, has led a few of the locomotive superintendents to provide their engines with boilers of more liberal dimensions, and some few have been constructed with a heating surface of from 1,200 to 1,500 square feet. Such cases are comparatively few, however, and we believe it is a fact to-day that about 1,150 square feet represents the average heating surface of an English engine. In this country locomotives of similar cylinder capacity would have from 1,500 to 2,000 square feet of heating surface.

The cause of the small size of English boilers is to be found partly no doubt in the fact that the fuel burned on the English roads is superior to ours, while there is no doubt that more attention has been paid to the question of economizing in the use of coal, premiums being generally paid to the firemen upon the amount saved out of a certain stated supply. The comparative lightness of the trains, as already mentioned, has also been a controlling factor, the service imposed upon an English engine being by no means so heavy as is common in this country. Perhaps the chief cause which has kept down the size of the boilers is the structural one which arose out of the fact that the large driving wheels which are common practice in England limit the diameter of the boiler to the clear inside space between them; unless, indeed, the boiler should be placed above the wheels, which would, of course, necessitate an engine with an unusually high center of gravity. When we consider that in the early battle of the gages in England it was a favorite argument of the broad gage partisans that engines running on the 4 foot 8½ inch gage would show a dangerous lack of stability, especially in running around curves, we can understand that the conservative tendencies of the English would make them hesitate before raising their boilers in order to admit of a diameter such as would cause the boiler to overlap the driving wheels, which frequently were between 7 and 8 feet diameter.

It was reserved for an American master mechanic, Mr. William Buchanan, of the New York Central and Hudson River Railroad, to show that this bold expedient could be undertaken without any positive risk, and, indeed, that its resulting effect, both in the running of the engine and upon the wear and tear of the track, would be highly beneficial. The first express engine with large driving wheels to carry the center of the boiler well above the tops of the wheel was the celebrated No. 999, which made its appearance in the year of the Chicago Exposition, and did its first work in hauling the Empire State Express between New York and Albany. The large diameter of the boiler, whose center, by the way, was no less than 8 feet 11½ inches above the rails, enabled the designer to get nearly 2,000 square feet of heating surface.

The first of the English roads to



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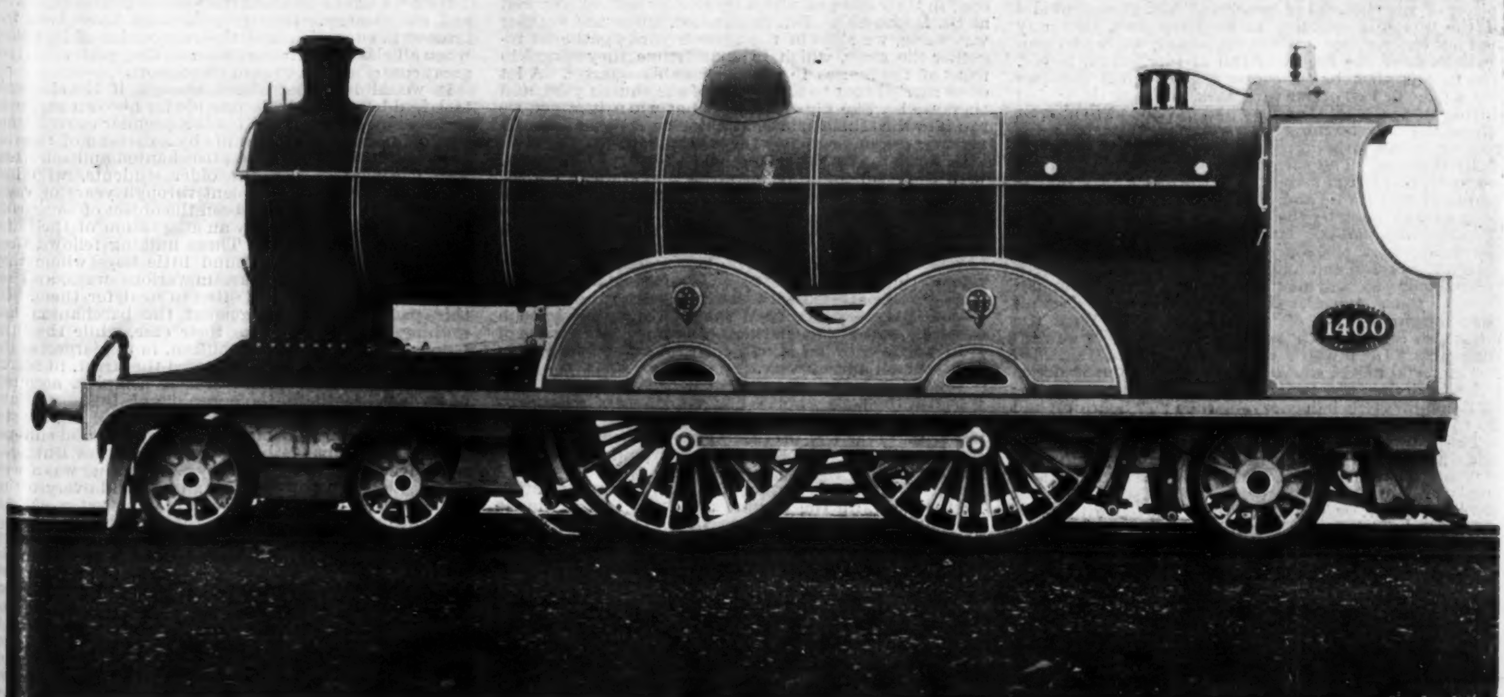


POWERFUL ENGLISH EXPRESS LOCOMOTIVE.

Cylinders, 19×26 in.; drivers, 7 ft. 3 in. diameter; heating surface, 2,052·8 sq. ft.; steam pressure, 175 pounds; weight of engine, 65 tons; weight of engine and tender, 100 tons; height from rail to center of boiler, 8 ft. 11 in.

adopt this method of construction was the Caledonian Railroad, which built several engines of the Dunalastair class with boilers of about 1,500 square feet heating surface and a high center of gravity. The results were so satisfactory that other locomotive superintendents in that country have begun to devise boilers of more generous capacity, always with good results. The latest and most striking development is the massive engine which forms the subject of our first page engraving. It was designed by Mr. Aspinall, the chief mechanical engineer, to meet the increasing demand of traffic on the Lancashire and Yorkshire Railroad. It is safe to say that this engine has reached the full limit of dimensions possible on an English railroad, where the loading gage is not by any means so large as it is in this country. The center of the boiler is 8 feet 11 inches above the tops of the rails, while the top of the smokestack is 13 feet 5½ inches above the same point. The engine is carried upon ten wheels, consisting of a four-wheel truck, four coupled driving wheels, and a pair of trailers. The driving wheels are both placed in front of the firebox, instead of being one in front and one behind, as is customary in English practice. This arrangement allows a very much longer firebox to be used, the outside length being 8 feet 1 inch, the outside width 4 feet 1 inch, and the depth from the center line of the boiler to the bottom of the foundation rim being 6 feet and ¼ of an inch. The total heating surface of the firebox is 175·8 square feet; the grate area is 26 square feet. The boiler barrel is 17 feet 1⅜ inches in length, and its smallest outside diameter is 4 feet 10 inches. The firebox, following the usual English practice, is of copper. The tubes are of steel; they are 239 in number, with a length between tube plates of 15 feet and an external diameter of 2 inches; the total heating surface is 2,052·8 square feet and the boiler pressure is 175 pounds per square inch. A peculiar feature of the construction is that the back plate of the flat top firebox is flanged on the outside instead of the inside, and the extended smokebox is placed within the shell instead of projecting forward of the smokestack. The driving wheels are 7 feet 3 inches in diameter, the truck wheels 3 feet and ⅜ of an inch, and the trailing wheels 3 feet and 7⅝ inches diameter. The cylinders are 19 inches in diameter by 26 inches stroke; they are placed inside the plate frames, with their steam chests above them. The engine alone weighs 65 tons, and the engine and tender 100 tons. The cab is of the usual English design, enlarged somewhat to meet the increased dimensions of the boiler; and it will be noticed in our view of the interior of the cab that the engine driver, as he is called, is provided with the unheard-of luxury of a seat. Beneath the seat can be seen the ends of the reversing cylinders, and just above it, to the right of the window, is the throttle lever, while a similar lever will be seen on the opposite side of the engine. The engine has the characteristic severity of outline and absence of visible running parts which characterizes the English locomotives. It has only recently been put in service, and its work will be watched with considerable interest.

UNIVERSITY OF PENNSYLVANIA LECTURE COURSE—III.

Student Life at the Close of the Middle Ages.*

If we look in upon German civilization at the close of the middle ages, we shall find a deep interest in education common to all classes. The schools are overrun with pupils; the highways leading to and from the great cities are thronged at times with migratory students. This is the condition of affairs about the year 1500; yet half a century earlier, Aeneas Sylvius, himself a noted Italian man of letters, who lived some years in Germany and knew it well, bore witness to the fact that the Germans had not yet developed an interest in the new learning. "They care only for their horses and dogs," he said, "and like horses and dogs they shall go down fameless to death." Whence then in half a century had come this change?

It is a simple matter to reply that the spirit of the Renaissance was in the air; but such a reply merely postpones the eventual solution. The Renaissance had been brewing in Italy for two centuries, and the Alpine passes open to trade, which is the great transmitter of the material of progress. Yet at the middle of the fifteenth century, as we have seen, Germany had not entered her intellectual period, while two generations later the land was full of intellectual fervor. The fact is, that half a century, although it occupies but a page or two of our text book, is a long time; and during this interval Germany had developed to a point where the new learning was welcome. Germany was passing in this interval from her agricultural to her industrial phase. The surplus of population, which for centuries had found its outlet in the great East, on the plains of the Baltic and the pustas of Hungary, had been turned back by the pressure of the Turks upon the Danubian lands. The energy formerly devoted to the conquest of the soil was turned to other forms of activity, to trade and industry. Cities sprang up, centers of commerce and manufacture, and from the human friction there engendered came an alertness of mind that sought sources of mental pleasure. With the cities also came wealth, and the possibilities of new indulgences. In a word, when Germany had satisfied her material needs, she rose to a higher plane of necessities, and then the Italian Renaissance was welcome; as Reuchlin's Greek master remarked: "Learning had flown across the Alps."

The humanistic movement and the intellectual fervor which accompanied it introduced a new democratic element into German society. In the middle ages society was fettered with distinctions of caste; prince, noble, burgher, or peasant, a man moved within the circle into which he had been born. The prizes of the new learning, on the other hand, were open to all. Indeed, the country lad, with his sense of economy, and the merchant's son, brought up to reckon values, were much more likely to win, in a struggle that called for steady toil, than the noble's son, spoiled with indulgence, his brain full of hawks and hounds, unable to stay cooped up behind a book. We find them in all the schools. The noble's son we meet only at the university. His early education he receives at home, at the hands of a tutor. The burgher's son has left but little account of himself. A city boy, he had no need to leave the paternal roof, and wander away to other towns to seek instruction in the common branches. Sometimes, to be sure, a well-to-do family in a small town would send its son and heir away to the city, where advantages were greater. A brief record of such a case was unearthed by a curious antiquary some years ago in the archives of Dresden. It consisted of two letters, written by the son of a prosperous middle class family to his parents. They date from the latter half of the fourteenth century, and are of value, because they show how eternal are the needs and frailties of schoolboy life. The writer, John Snyder, as is not unusual, had exhausted his funds before the close of the school year. The result is two letters; one to his father, in Latin, for the purpose of exhibiting his intellectual progress; the other in German to his mother, conceived with an adroitness instinctive with all boys. To the father he writes in atrocious Latin, which tells of fruitless struggles with the lexicon, as follows: "To the distinguished man, John Snyder, living in Hainau, his most beloved father: First of all receive assurances of my filial obedience, with the constant ardor of my love for my father. Surely the branch will soon wither which does not receive nourishment from its root; hence, beloved father, I am forced to confess to your paternal affection, that the rigors of the past winter have quite exhausted the money you in your kindness sent me for daily necessities. Since I am burdened with divers wants from which I am unable to be relieved, except through a paternal remittance, I therefore appeal to your fatherly affection with humble and devout prayer, that you will charitably succor me in my distress, and not delay in sending me the trifle of six florins by this messenger, in order that the spring which you have planted may be seen to flourish and not wither. In so doing you will cherish your own honor, and increase that of your son as well.

"Jno. Snyder, Scholar at Garlitz."

Thus to the father; to the mother, in the vernacular, he wrote:

"To the prudent and virtuous lady, Mrs. B. Snyder, in Hainau, his dearest mother who bore him. Receive, first of all, constant assurances of filial devotion with true love. Dearest mother, your maternal love will kindly understand that for a long time I have suffered great need in the matter of my linen, as, for example, bedclothes and shirts; and that I still suffer greatly, so that I am quite robbed of my night's rest. Therefore, I earnestly implore and beg of your kindness, you who have ever shown me goodness and love, that you send me at once, by the bearer of this letter, a pair of sheets and three shirts; and that you urge and encourage my father to help me, in order that through your motherly love I may seek to deserve forever the special blessing of God. Jhn. Snyder, of Hainau, Scholar in Garlitz."

A great many boys, no doubt, were like John Snyder, in touch with the parental strong-box; but their records have not come down to us in abundance, chiefly because their school life was uneventful. It is the poor scholar, dispatched from home with a silver ducat and a heart full of blessings, trusting to fortune to bring him out aright, who has put his mark upon student life at the close of the middle ages.

In the eyes of a prosperous citizen of the fifteenth century nothing was more desirable than that his city should be the educational center for the country round about. Special inducements were accordingly offered in the way of bursaries, or free dormitories. These buildings, erected by pious individuals more often than at public expense, were cell-like structures adjoining the school or the parish church. They would be uninviting to the modern taste, but the middle age asked less in the way of domicile, and these rude cells not only provided lodging, but also warmth, for fuel was supplied at the town's expense. Yet numerous as the bursaries were, the demand was greater still, and contemporary accounts picture the student wandering from town to town until an empty cell gave him the opportunity of settling down to the winter's work. "The little boys," says Thomas Platter, in his autobiography, one of the best accounts of school life at this period, "slept on the stove at the school, the larger ones in their cells, of which there were several hundred at St. Elizabeth's. But in summer, when the weather was warm, we slept in the church yard; gathered together the grass, which in summertime they spread in front of the houses in the fashionable quarter. A lot of us carried that to the corner of the church yard, and there we lay like pigs in straw; but when it rained we ran into the school house, and during a thunder storm we sang responses almost the whole night long."

In large towns the schools of the different quarters, with their surrounding bursaries and student bodies, were like armed camps, full of mutual hostility and local antagonism. The pitched battles which were fought in the streets between the rival bands filled the town with tumult. Each school was eager to enroll a promising new-comer in its ranks. Johannes Butzbach relates that when he entered Nuremberg for the first time he was saluted with cat-calls and all manner of discouraging epithets from the students; but as soon as they learned that he had come for the purpose of study, they crowded about, each sounding the praises of his school and bursary.

With these two wants provided for, lodging and warmth, the poor scholars had yet others of still greater importance, in tuition and food. For tuition was not free. Teachers of the higher branches were dependent for support upon the fees paid by students who attended their classes. There were no school taxes. With the exception of a possible appropriation for fuel to warm the bursaries, the city treasury made no contribution toward education. It was as private individuals, and in the way of alms, that the citizens made up the large contribution necessary for the support of this great body of impecunious students.

There were practically two ways in which a scholar might defray the expenses of food and tuition. He might take service in the house of a well-to-do citizen, and secure his food and clothing and such additional pay as would meet his class room fees. Such service must, of course, allow him sufficient time for class work and for study. It generally consisted in attending the sons of the family on the way to and from school and running errands. Very often such aid was purely a matter of charity. Johannes Butzbach found at Münster a pious widow of means, who constantly entertained a number of poor scholars. There were many good people all through Germany who were disposed to do the same, according to their abilities.

The other way of securing food was by begging; and this was what the greater part of the poor students did. In fact, in a town containing a large school, pretty much all charitable offerings of citizens were devoted to the support of students. So great was the burden thus imposed upon the community, that in some cases a municipal enactment provided that no one, not actually engaged in study in the town, should be allowed to beg his bread upon the street, and often the begging was limited to the quarter in which the school was situated. It could safely be left to the students themselves to see that these provisions were obeyed. As a matter of fact, the scholar rendered some equivalent for the alms bestowed. The fifteenth-century scholar was the street musician of his time, and his performances were vocal. He went to school during the morning, and in the afternoon he sang for his supper. In Heinrich Deichsler's chronicle of Nuremberg, in the year 1493, occurs a plaintive note of student life, showing the tender years of the little student waifs who sang in the streets of this old city. "The same year after the festival of St. Margaret," the chronicle reads, "there came a crazy man here from Rothenburg; his father was named Weytschuch, a tailor. A poor scholar was singing for his bread in the Kromergasse, when this madman rushed into the street, and stabbed the scholar eight times in the neck and elsewhere with a dagger. They took the wounded boy at once into Schaub's house, but he died in the woman's lap immediately. He was ten years old."

The vicissitudes of mendicancy are well illustrated in the account of his experiences given by Burkhard Zink in his chronicle of Augsburg. "I arose," he says, "took my school books and asked my sister and her husband for some money for my journey. They gave me sixteen heller and no more, and with these in my pocket I went the same day to Waldsee, and there spent the night in the hospice, for I had not much to spend. Next morning I rose early and made my way to Biberach, and immediately upon my arrival I fell in with a pious man (he was very rich and had been a shoemaker, but was no longer working at his trade), who was willing to give me lodging for a year or longer, so that I might go to school; but I was to find my bread. So I went for fourteen days to school, and was ashamed to beg; and each day when I came from school I bought me a groschen's worth of bread and cut pieces from it; and when I came home my master asked me if I had been in the city, singing for bread, and I answered that I had. And then he said: "They give very willingly to poor scholars here." So I went along until my money was exhausted; but still I was unwilling to beg, when a scholar came to me and asked me if I would go with him, and I did so. When we came there I found the big scholars, and they all of them begged in the city for their bread. I went with them and did the same. I was perfectly willing to beg now, and felt ashamed no longer, but did so well that I had plenty to eat.

"Now while I was a Ehingen and had gone to school there about six months, a big scholar approached and asked me if I would go with him to Balingen, where there was a good school, saying that he would help me to get a good place there, where they would pay me something, and that he would help me and advise me. Thus he won me over with his plausible words, and I went with him to Balingen, which is a little town, lying one mile from Hochenzoll; and having come to Balingen, I remained there a whole year. I went into school, but my companion left me and gave me neither help nor counsel. Therefore I went to a poor man, a smith, named Spilbeutz, in whose house I remained for a time; and I conducted his boy to school. Afterward I went to an inn keeper, who gave me my whole living, so that I had no need of begging. Later I left there and came to Ulm, where I remained a whole year in the house of a piper, who was the city piper, by name Hänslein von Biberach; and truly he used me well. I conducted his boy to school, who has since become himself a piper. I begged my bread."

Here we have combined the various phases of service and mendicancy. How general must have been the interest in education and the recognition of its value, when all classes of citizens were making such relatively great contributions toward its support.

It would have been hard enough, if the student's task had been merely to provide for his own support; but the fifteenth century made a peculiar contribution to the burdens of student life by a division of the student body into two classes, bacchanten and schützen. The bacchanten were the older students, who had grown perverse and indolent through years of vagabondism. The name has been the object of some controversy, but is very likely an adaptation of the Latin vagantes or wanderers. These hulking fellows, tired of begging their bread, found little boys whom they picked up here and there, in various ways, and set them to work to beg and often to steal for them. By this padrone-like management the bacchanten had nothing to do but to take their ease, while the little fellows, who were called schützen, in the jargon of the highway (that is, beggars) roamed the street, in search of food and money. The two most complete accounts of student life, the autobiographies of Johannes Butzbach and Thomas Platter, already mentioned, are stories told by men who once were schützen, and suffered all the hardships of the system. Johannes Butzbach was born in the Rhine country. His father was a weaver, not too prosperous, with a large and overgrowing family. One day, when Johannes was yet a child, a cousin came to visit in the neighborhood. This cousin was a scholar, and the Butzbach family were greatly impressed with his learning and fine manners. In the course of conversation he offered to take Johannes with him and make a scholar of him too. The mother was filled with ambition for her son; Johannes was rigged out with new apparel, given a sum of money and set afloat. The student had given promise of great things; over the mountains the roofs were tiled with sausages. But Johannes found schützen life a very different thing. At the first great town the cousin summoned a party of friends to a banquet and ate and drank

* A lecture delivered March 13, 1899, by Merrick Whitcomb, Ph.D., Instructor in Modern European History, University of Pennsylvania, at the University College Hall. Specially prepared for the Scientific American Supplement.

away Johannes' slender hoard, while the little boy himself lay behind the stove, footsore with travel and forgotten. Instead of a favored protége he found himself a slave. There was no chance for learning; the task of furnishing his bacchanten with food and drink occupied his whole time. For six years he wandered, buffeted about from town to town, until finally he succeeded in getting back to his home. In all this time he had learned nothing. When later on he yielded to a desire for further study, and went down the Rhine to Deventer, he had to sit in the lowest classes, with the little boys, and learn the rudiments of Latin. Yet so great was his courage and so persistent was his effort that he became the head of the great Abbey of Lorch, and one of the leading humanists of Germany.

Thomas Platter's experiences were very similar. A Swiss boy, brought up to herd goats in the mountains, an orphan, for whom nobody was responsible, he was readily picked up by a plausible bacchanten, spending his vacation in the Alps. He was small for his age, and frail, and therefore particularly good material for a schützen, whose most esteemed qualification was the ability to excite pity. They set off on their journey, joining themselves to a party of Swiss students, and Thomas Platter's hardships began. He learned to beg and steal and fight, but there was little schooling. Here is a part of his experience: "Soon after that we came back to Ulm and Paulus took another boy with him, named Hildebrand Kalbermatter, a parson's son. He also was young, and someone gave him a piece of cloth, such as they made in that region, for a jacket. When we came to Ulm, Paulus ordered me to go about with the cloth and collect money to have it made up. In that way I got considerable money, for I was well acquainted with the art of begging. The bacchanten had always used me for that purpose instead of sending me to school, and they had not even taught me to read. I went to school but seldom, and while they were at school I went about with the cloth. I suffered greatly from hunger, for everything I obtained I brought home to the bacchanten. I dared not take a bite, for I feared a beating. Paulus had associated with him another bacchanten, Achatius by name, a native of Mainz, whom I and my fellow-schützen, Hildebrand, had to support with begging; but my companion ate almost everything himself; and the bacchanten used to follow him through the alleys, so that they might catch him eating, or they made him rinse out his mouth with water, and spit into a dish, so that they could see if he had eaten anything. Then they threw him upon a bed and put a pillow upon his head, so that he could not cry out, and beat him, these bacchanten, until they could beat him no longer; wherefore I was afraid and brought everything home."

How small must have been the proportion of boys that came unscathed through these demoralizing experiences? Contemporary records tell us that a greater part perished with want and disease, or went to swell the number of those who kept the hangman busy. Butzbach and Platter struggled through, thanks to some sterling residuum that successfully resisted the corrosive influence of evil association. Butzbach's success in life has already been related. Platter came to be one of the important men in Swiss Protestant life, and died full of years and honors.

Turning from student life to the schools themselves, which were, at least in theory, the objective points of all this wandering, we find an infinite variety. Each school seemed to be the outgrowth of local conditions and demands. The universities still had the monopoly of the professional schools, of law, medicine, and theology; but it would have been as difficult to distinguish between the faculty of arts and letters at the university and the Latin schools as it would at the present time to draw the line between high schools and colleges. The majority of the boys who thronged the highways in search of food and knowledge were pupils of the Latin schools. Some of the larger Latin schools, such as Münster, Emmerich, and Deventer on the lower Rhine, and Schlettstadt near the upper Rhine, between Strasburg and Basel, were veritable centers of the new learning. They were graded, and pupils passed from one grade to another, after an examination before the principal and his assistants. When Johannes Butzbach, after years of wandering, finally made his way to Deventer and took up his studies in good earnest, he entered the eighth grade and sat with little boys. During the year, however, on account of diligence and maturity of mind, he made his way to the fifth grade. In the same way, Thomas Platter, after some years of service as a schütze, came to Emmerich. "When I came to the school, I could read nothing," he says, "not even the Donat; and I was already eighteen years of age. I sat with the little children, but was like a hen in the midst of her brood of chickens. One day Sapidus, the master, read the names of his pupils. 'I have here,' he said, 'many outlandish names (barbara nomina). I shall have to Latinize them a little.' Then he read further; he had me written down. First came Thomas Platter and my comrade, Antoni Venetz; he had translated our names to Thomas Platterus and Antonius Venetus. He called out: 'Where are those two?' We stood forward, and he cried: 'Fie upon you! Two such mangy schützen and have such pretty names!'"

The early grades devoted most of their time to the study of Latin, and the favorite text book was the Donatus, as it was called from its author, Aelius Donatus, a Roman grammarian of the fourth century. There are two Donats, the lesser and the greater, and it is to the lesser that Thomas Platter refers. He was so impressed with the importance of the book that he resolved to commit it, word for word, and did so. The task was not so great. The lesser Donat would occupy about a dozen pages of an ordinary octavo volume, and is divided into chapters, each treating of a part of speech. The text is continuous, not broken up with paradigms, as in our modern grammars. The greater Donat was expanded to embrace prosody and remarks upon the various figures and errors of speech. No book has been more closely associated with the school life of medieval and early modern times than the Donatus. It grew into the languages of Europe, and came to have the same signification as our "A B C"—that is to say, it stood for the beginning of things. "It is in its Donat," you might say of a thing just beginning to develop.

From the Donat the progressive student in medieval times took up the so-called Doctrinale, a Latin grammar written in the twelfth century by Alexander de Villedieu. By a singular perversity of the medieval mind the text of this celebrated grammar was thrown into Latin hexameters, and so much clearness was sacrificed to metrical elegance, that it was as much as ever the student could do to determine the drift of Alexander's observations. It was this sort of book that the Renaissance dispossessed, and for them were substituted the works of classical grammarians, or the more recent adaptations of Italian humanists, like Aldus and Guarino. This was one of the considerable changes that the Renaissance brought about in German schools; another was the substitution of classical texts for the works of church fathers and scholastics, whose style had degraded the Latinity of the middle ages. This was the beginning of that process of sifting the wheat from the chaff which has gone on until, in modern times, our schools deal wholly with the masterpieces of antiquity. Before the Renaissance any Latin was good Latin, and the best qualification for an author was his orthodoxy.

A third work of the humanistic movement was to enlarge the sphere of knowledge. The desirability of reading Aristotle and Plato and Homer in the original made necessary a knowledge of Greek. In the same way with Hebrew. This language seems to have been credited with greater resources in a literary way than it really possesses, owing, no doubt, to the enthusiasm of Pico della Mirandola and his German pupil, Reuchlin, for the Kabbala and other Hebrew writings. The introduction of Hebrew into the secondary schools, on an equal footing with Greek, was an impetus which posterity has not justified.

At the Emmerich school, one of the most progressive of its time, the curriculum, as noted by Heinrich Buldinger, at the beginning of the sixteenth century, was as follows: "Rudiments of Donatus and grammar of Aldus Manutius, with daily exercises at school and at home. Every day the class declines, analyzes, and conjugates. Daily readings in Pliny, Cicero, Virgil, Horace, poems from Baptista Mantuanus, and letter of Jerome and others. Every week a letter to be written, Latin invariably spoken. Rudiments of Greek and dialectics. Strict discipline and religious exercises."

As regards the method of instruction in the Latin schools, in the lower grades the recitation seems to predominate. In the fifteenth century few pupils came to school with text books, on account of the high price of books and manuscripts. In most instances the material of instruction had to be dictated by the master and copied by the pupils, before the text could be taken up for a more careful examination. When Cicero or Virgil was presented, for example, the instructor dictated as much of the text as might be dealt with during the period, then explained the difficult passages, commented upon them, analyzed and construed them, so that at the close of the course the student went away with his copy of the text and annotations for future use. The same methods were in vogue in the non-professional departments of the university; the only difference being that the lecturers were famous humanists or presented less known authors; and in addition to this there was the formal disputation, for instruction in dialectics was a more considerable feature of the university than of the Latin school. The university, however, lacked wholly the graded system of the Latin school, and the course was indefinite. When the student felt himself prepared, and he had passed through the requisite number of public disputations, he came up before the faculty for his degree.

Thus the student lived by hook or crook, and nibbled away at that body of classic lore which, buried with the fall of Rome, had been easily found again when a barbarian civilization evolved itself to the point of needing it for further progress. While school was in session all was well, but when vacation came with summer, the student body drifted away upon its migratory course; some who had parents or friends nearby were well provided for; but many were far from home or else no longer welcome. Such as these took to the countryside and strolled about, living by their wits. We have a contemporary account which shows these summer students in somewhat unflattering light. The Book of Vagabonds, written about 1510, treats of the various kinds of wandering people one could meet on the highway. Of students it has to say as follows: "They wear yellow garments, come out of Lady Venus Mountain, know the black art and are called wandering scholars. When they come into a house, they begin to talk as follows: 'Here you have a wandering scholar, master of the seven liberal arts, and (to commend themselves to the peasants) an exorcist of the devil, for hail, for storm, and for all demons.' Then he utters certain mystic words, makes two or three signs of the cross and says:

'Where these words are spoken,
There shall no bones be broken,
Nor ill luck be at hand
To those in all this land,'

and many other precious words. Then the peasants believe him, that all this is true, and they are glad that he is come, for they have never seen a wandering scholar, and they say to the bacchanten: 'This or that thing has happened to me; if you can help me, I will give you a florin or two.' Then he says 'Yes,' and fools them to the top of their bent. Thus they go about with tricks, and the peasants believe, from what they say, that they are able to exorcise the devil, so that they can help them, no matter what is the matter with them, for you cannot ask them anything but they will apply their tricks to it; that is they will cheat you out of your money. Conclusio: Look out for these bacchanten, for where they go about, all is lies."

CAGLIOSTRO'S PARIS HOUSE.

CAGLIOSTRO'S house still stands in Paris. Few alterations have been made in it since the days of its glories and mysteries; and one may easily imagine the effect which it produced in the night upon those who gazed upon its strange pavilions and wide terraces when the lurid lights of the alchemist's furnaces streamed through the outer window blinds. The building preserves it noble lines in spite of modern additions and at the same time has a weird appearance which produces an almost depressing effect. But this doubtless comes from the imagination, because the house was not built by Cagliostro; he simply rented it. When he took up his quarters in it, it was the property of the Marquis d'Orvillers. Cagliostro made no changes in it, except perhaps a few temporary interior additions for the machines which he used in his séances in magic.

The plan of the building may well be said to be abnormal. The outer gate opens upon the rue Saint Claude at the angle of the boulevard Beaumarchais. The courtyard has a morose and solemn aspect. At the end under a flagged porch there is a stone staircase worn by time, but it still preserves its old iron railing. On looking at that staircase one cannot help thinking of the hosts of beautiful women, attracted by curiosity to the den of the sorcerer, and terrified at what they imagined they were about to see, who placed their trembling hands upon that old railing. Here we can evoke the shade of Mme. de la Motte running up the steps, with her head covered with a cloak, and the ghosts of the valets of Cardinal de Rohan sleeping in the driver's seat of the carriage with a lantern at their feet, while their master, in company with the Great Copht, is occupied with necromancy, metallurgy, cabala or oneirocritics, which, as everybody knows, constitute the four elementary divisions of Cagliostro's art.

A secret stairway, now walled up, ran near the large one to the second story, where its traces are found; and a third stairway, narrow and tortuous, still exists at the other end of the building on the boulevard side. It is in the center of the wall, in complete darkness, and leads to the old salons now cut into apartments, the windows of which look out upon a terrace which still retains its old iron balconies. Below, with their mouldering doors, are the carriage house and the stable—the stable of Djérid, the splendid black horse of Lorenza Feliciani.

It was in the summer of 1781 that the Comte de Cagliostro first appeared in Paris. All sorts of fantastic stories have been told about him. According to the most authentic records, he was a rather badly built man, clad in poorly cut blue taffeta, laced on the borders. He wore his hair in a startling and most ridiculous style, with powdered plaits bunched in cadenettes. His silk stockings were embroidered in gold and the buckles of his velvet shoes sparkled with precious stones. The display of diamonds on his fingers and watch chains went beyond the line of vulgarity. His head dress was a pointed hat ornamented with white plumes. During eight months of the year he wore a great blue fox cloak, augmented by a fur capuchon in the form of a carapousse. On the street he was a walking scarecrow, and the children used to flee from him in terror. His features were regular, his complexion clear, his teeth superb, and his eyes were so marvelous that they defied description. His wife, the Comtesse Lorenza, was rarely seen, but by all accounts she was a woman of bewildering beauty, realizing the Greek lines in all their antique purity and enhanced by an Italian expression. The most enthusiastic of her so-called admirers were precisely those who had never seen her face. There were many duels to decide the question as to the color of her eyes, some contending that they were black and others that they were blue.

Duels were also fought over a dimple which some admirers insisted was on the right cheek, while others said that the honor belonged to the left cheek. She appeared to be no more than twenty years old, but she spoke sometimes of her eldest son, who was for "some years a captain in the Dutch army."

One may imagine the emotion that was caused in the Marais quarter by the installation of such strange tenants in the hotel of Mme. d'Orvillers. It was the Cardinal de Rohan himself who selected and furnished the place for the mysterious hosts. He used to visit Cagliostro three or four times a week, arriving at dinner time and remaining until an advanced hour in the night. It was said that the great cardinal assisted the sorcerer in his labors, and many persons spoke of the mysterious laboratory where gold bubbled and diamonds sparkled in crucibles brought to a white heat. But nobody except Cagliostro, and perhaps the cardinal, ever entered that mysterious laboratory. All that was known for a certainty was that the apartments were furnished with oriental splendor and that Count Cagliostro in a dazzling costume received his guests with kingly dignity and gave them his hand to kiss. Upon a black marble slab in the antechamber carved in golden letters was the universal prayer of Pope: "Father of all! in every age," etc., the parody of which ten years later Paris sang as a hymn to the Supreme Being.

Among the many stories told of Cagliostro, that of the supper in the hotel of the rue Saint Claude, where the ghosts made merry, still holds the record. Six guests and the host took their places at a round table upon which there were thirteen covers. Each guest pronounced the name of the dead man whose spirit he wished to appear at the banquet table. Cagliostro, concentrating his mysterious forces, gave the invitation in a solemn and commanding tone. One after another the six guests appeared. They were the Duc de Choiseul, Voltaire, d'Alembert, Diderot, the Abbé de Voisenon, and Montesquieu. Surely one might be in more stupid company!

When the living diners recovered their breath, the conversation began, but, unfortunately for the great ghosts, the record of their conversation makes them talk stupid nonsense. Perhaps this may be taken as evidence of the theory that a man loses his head when he dies. At all events, the story created a sensation in Paris. It reached the court, and one evening, when the conversation turned upon the banquet of the ghosts, the king frowned, shrugged his shoulders, and resumed his game of cards. The queen became indignant and forbade the mention of the name of the charlatan in her presence. Nevertheless, some of the lightheaded ladies of the court burned for an introduction to the superb sorcerer. They begged Lorenza Feliciani to get him to give them a course of lectures or lessons in magic to which no gentlemen were to be admitted. Lorenza replied that he would consent, provided there were thirty-six pupils. The list was made up in a day, and a week afterward the fair dames got their first lesson. But they talked of it, and of course the story got loose. This caused another scandal, and consequently the first lesson was the last.

When Cardinal de Rohan was sumptuously installed

in the rue Vieille-du-Temple, he had for his near neighbor the Comte de la Motte, whose wife, an adventuress of the first rank, boasted of her ability to conquer the antipathy of the queen in regard to the alchemist. Mme. de la Motte lived in the house that formed the north angle of the rue Neuve-Saint-Gilles and the boulevard Beaumarchais. She first made the acquaintance of Lorenza and afterward that of Cagliostro, who introduced her to the cardinal. Then followed the well-known intrigue of the diamond necklace. The cardinal, the "woman la Motte," and Cagliostro were arrested, and here is the latter's own account of his mishap:

"On the 22d of August, 1786, a commissaire, an exempt and eight policemen entered my house. The pillage began in my presence. They compelled me to open my secretary. Elixirs, balms, and precious liquors all became the prey of the officers who came to arrest me. I begged the commissaire to permit me to use my carriage. He refused! The agent took me by the collar. He had pistols, the stocks of which appeared from the pockets of his coat. They hustled me into the street and scandalously dragged me along the boulevard all the way to the rue Notre-Dame-de-Nazareth. There a carriage approached which I was permitted to enter to take the road to the Bastile."

Ten months later the poor Great Copht returned crestfallen to his home in the rue Saint-Claude. Nevertheless, he received a warm greeting. From eight to ten thousand people crowded the boulevard. They cheered him, kissed his hands, and carried him in triumph into his house. But his triumph was short-lived. On June 13, 1788, the agent des Brunnières brought to Cagliostro an order from the king to leave Paris in twenty-four hours and France before the end of two weeks. This was something that the great magician should have foreseen, but probably the wheel in his head which ran the predictions had become rusty during his stay in the Bastile. He bowed to the agent. Then he closed the door of his laboratories, put the key in his pocket, drove to Saint-Denis and put up at the Hôtel de l'Epée Royale, where he passed the night. Then, with Lorenza, he bade farewell forever to Paris, and proceeded to Switzerland. His mansion remained closed and intact during the revolution. For eighteen years that ghost house was undisturbed. It was not until 1805 that the doors were opened, for the purpose of auctioning off the furniture and rare belongings of the Great Copht, who was sadly behind in his rent. "Public sale of the furniture, crucibles and elixirs of the Comte de Cagliostro!" Oh, what a splendid poster for an auctioneer, and what a bait for a collector! Since then the gloomy house of the rue Saint-Claude has had no history. Ah, but I am mistaken. In 1855 some repairs were made. The old carriage door was removed, and the one that took its place was taken from the ruins of the Temple. There it stands to-day with its great bolts and immense locks. The door of the prison of Louis XVI. closes the house of Cagliostro! How strange!—From the Courrier des États Unis.

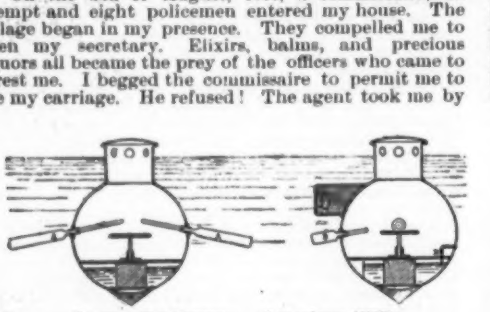
Beware of the unwashed telephone. It is a constant menace to the public health. A bacteriologist tells us that more cases of influenza have been coughed, spluttered and sneezed into the telephone, to be contracted by the next user of the instrument, than have proceeded from all other sources combined. Our informant visited several hotels, and also a number of public telephone exchanges. He carried with him some wire and clean cotton. He mounted the cotton on a piece of wire and rubbed it around the inside of the mouthpiece of the telephone receiver. These were each placed in a small bottle and carefully sealed. The first cotton ball examined revealed a multitude of the influenza bacilli, and it was so with the scrapings from all of the telephones. It is thus quite plain that the wide prevalence of the disease is partly due to the use of infected telephones. It is known that the germs are contained in the secretions, and nothing is more natural than that they should reach the transmitters.—Science Siftings.

THE PROGRESS OF SUBMARINE NAVIGATION.

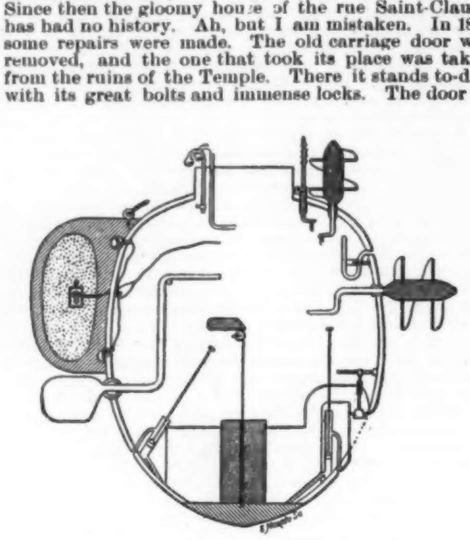
THE competition opened two years ago at the office of the Minister of the Marine for the elaboration of a project for a submarine torpedo boat seems to mark the centenary of the first series of attempts at submarine navigation, which were made in France, in the year 1797, by Robert Fulton. The problem that proves so exciting at the close of the nineteenth century already stood in the front rank of serious studies at the end of the eighteenth. How much nearer the solution inventors are at present, in what manner they have approached it, what stages have marked the course pursued, what difficulties have been surmounted, and how they have been overcome, will appear quite clearly in the following.

Therein the reader will find brought together all the notable plans of submarine boats that have been designed (and for the most part carried out) from the time of Fulton and of his precursor, Bushnell, up to that of Messrs. Gustave Zédé and Romazzotti.

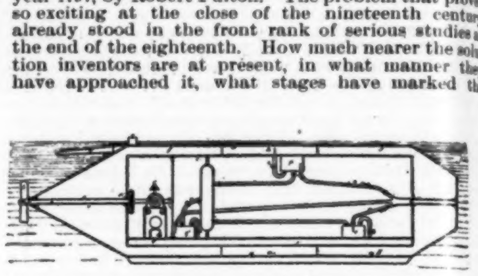
The collection of these data represents a large amount of patient and intelligent research, for which L'Illustration is indebted to M. Forest, one of the prizemen of the competition of 1897. Of projects offering an interest, M. Forest brought to light no less than one hundred and eighteen. Forty of these, the design of which he succeeded in finding or reconstructing, are grouped herewith. Scarcely any of these figures has ever before been published. The description which accompanies each of them comprises: (1)



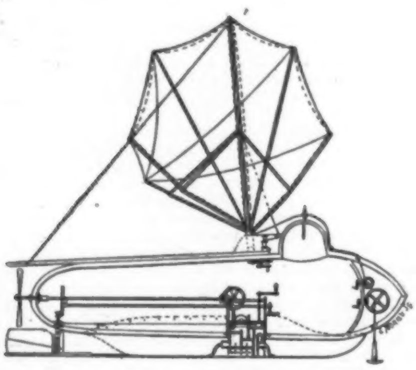
DAVID BUSHNELL. American (1773).
The "Turtle." Diameter, 8·25 feet; propulsion by means of oars; submersion through the introduction of water; armed with a rudimentary torpedo; constructed of copper.



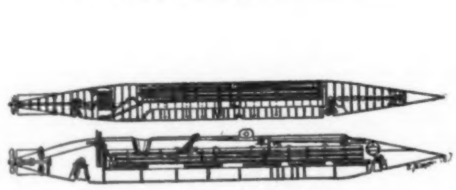
The "Tortoise" according to another document.



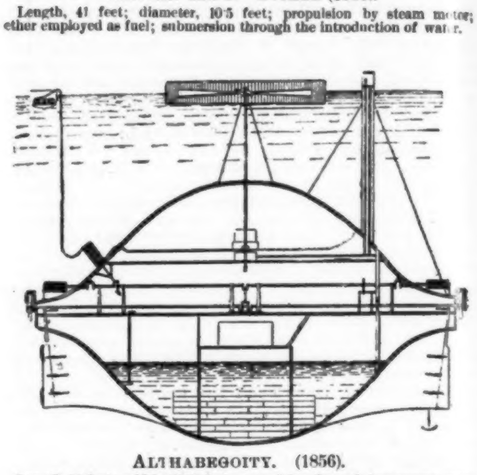
OLIVIER RIOU. French (1861).
Length, 41 feet; diameter, 10·5 feet; propulsion by steam motor; ether employed as fuel; submersion through the introduction of water.



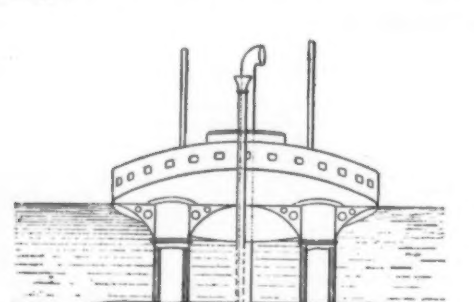
ROBERT FULTON. American (1797).
The "Nautilus." Length, 21 feet; diameter, 6·5 feet; propulsion by sail while afloat, but by a wheel while submerged; constructed of iron and copper.



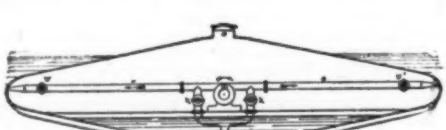
PHILLIP. American (1851).
Two models. Length, 39·25 feet; diameter, 4 and 5 feet; propulsion through a screw actuated by hand; submersion through the introduction of water; No. 2 armed with a submarine gun.



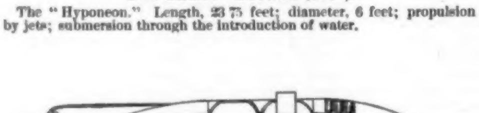
ALPHABEGOITY. (1856).
Length, 82 feet; width, 39·25 feet; propulsion through two screws actuated by a motor the nature of which is unknown; submersion through the introduction of water and with the aid of a vertical screw; constructed of wood.



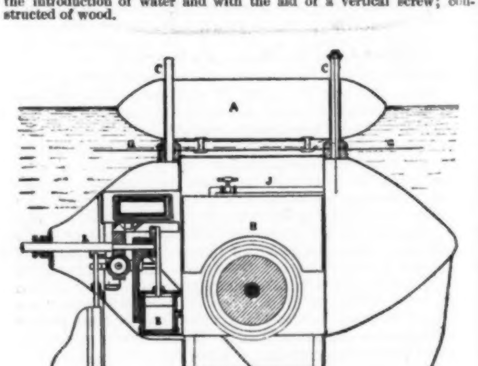
DONATO TOMMASI. Italian (1876).
Length, 32·8 feet; height, 19·5 feet; propulsion by a screw and steam motor; submersion through the introduction of water.



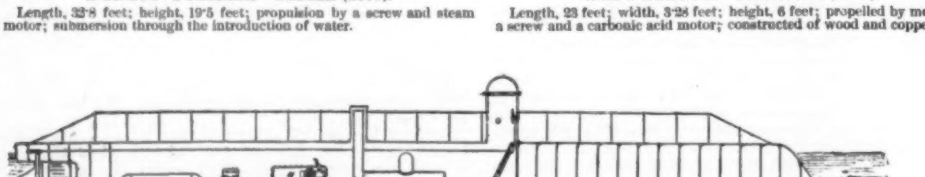
TOUREAU. French (1886).
The "Hyponeon." Length, 23·75 feet; diameter, 6 feet; propulsion by jets; submersion through the introduction of water.



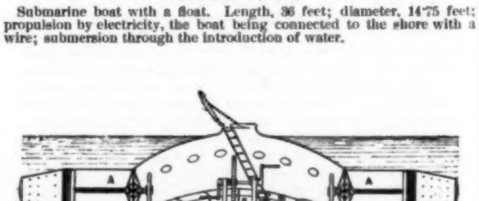
DR. BARBOUR. American (1869).
Length, 23 feet; width, 3·28 feet; height, 6 feet; propelled by means of a screw and a carbonic acid motor; constructed of wood and copper.



SMITH. (1873).
Submarine boat with a float. Length, 36 feet; diameter, 14·75 feet; propulsion by electricity, the boat being connected to the shore with a wire; submersion through the introduction of water.



ALSTITT. American (1863).
Length, 69 feet; height, 10 feet; propulsion varied (steam engine while afloat and electric motors while submerged); submersion through the introduction of water.



ANDRE CONSTANTIN. French (1874).
Length, 19·5 feet (36 feet with the pistons); diameter, 16·5 feet; propulsion through a screw actuated by hand by means of two cranks; submersion through a diminution of bulk obtained by means of hydrostatic pistons.

THE PROGRESS OF SUBMARINE NAVIGATION.

the name and nationality of the inventor; (2) the date of the invention or that of the experiments; (3) the principal dimensions of the boat; (4) an indication of the method of propulsion and submergence adopted; and (5) an indication of the materials of construction and of the armament.

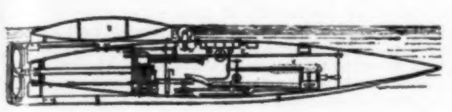
These succinct data constitute the skeleton, as it were, of the history of submarine navigation. We could not think of completing such history in this place, since a volume would be required for that purpose. We shall, therefore, confine ourselves to a presentation of a few necessary explanations, and to a grouping of some of the data embraced in M. Forest's diagrams.

The submarine boat that begins the series is that of Bushnell, an American. Antedating Fulton's "Nautilus" by twenty-four years, Bushnell's "Tortoise" itself had a few predecessors. The first of all known projects for a submarine boat appears to have been that of William Bourne, in 1604. Twenty years afterward Cornelius van Dribbel constructed a wooden diving boat, having tight joints of oiled leather, and which was capable of accommodating fifteen persons. It was propelled by twelve oarsmen and performed its evolutions under the waters of the Thames in the presence of a large number of spectators, among whom was James I. There are also mentioned Fathers Mere and Tournier's submarine boats of 1634, and Day's boat of 1660, which latter remained with its inventor at the bottom of the water. But David Bushnell's "Tortoise" was really the first diving boat that gave indisputably good results. Although the form to which it owed its name was not very favorable to speed, it at least assured to the strange craft very great stability. The "Tortoise" was capable of holding but one person, and was provided with a supply of air sufficient for a submersion of half an hour. Beneath the hull, the lower part of which served as a submersion reservoir, there was fixed a mass of lead forming a ballast. The propulsion was effected by means of two oars that protruded from the hull through two double sockets of oiled leather, which permitted the submarine navigator to turn the oar blades edgeways or horizontally in working them backward and forward.

According to certain authors, Bushnell did not employ oars, but genuine sustaining and propelling screws actuated by means of winches. One of our figures interprets this quite unlikely version, according to which we should have to attribute to Bushnell (and put back at least fifty years) that discovery of the application of the screw to navigation which covered Sauvage with glory.

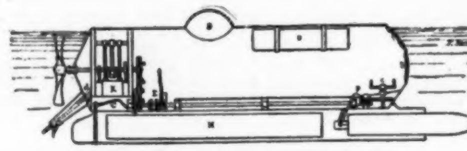
However this may be, while refusing Bushnell the merit of having been the first to use the screw, the fact must be recognized that his experiment was, in many other respects, a master stroke. His embryo

THE PROGRESS OF SUBMARINE NAVIGATION



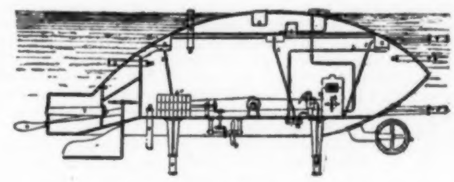
DAVIES. (1883).

The "Demon." Length, 50·75 feet; diameter, 7·25 feet; propulsion by a compressed air motor; submersion through a horizontal rudder; armed with a torpedo.



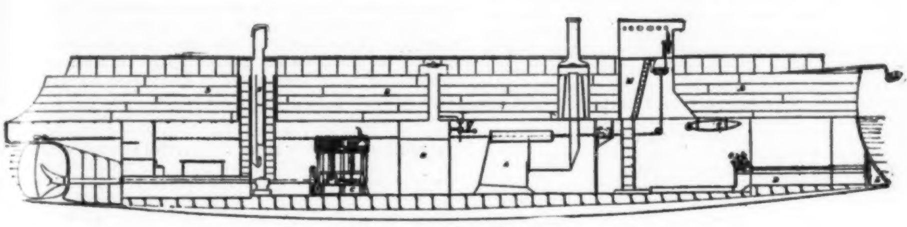
FLAIS. French (1885).

Length, 21·25 feet; diameter, 5 feet; propulsion by a gas motor; submersion through a reduction of volume; provided with a torpedo tube. *A* and *B*, scuttles; *C*, rudder wheel; *D*, commander's station; *E*, gearing; *K*, gas motor; *M*, reservoir of compressed air; *N*, reservoir of compressed gas.



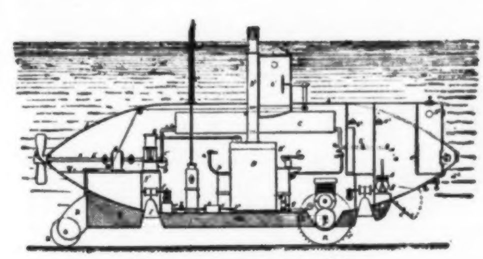
BOUCHER. French (1885).

Length, 49·25 feet; diameter, 14·75 feet; propulsion by a screw; power used unknown; armed with submarine guns; protected by buffers.



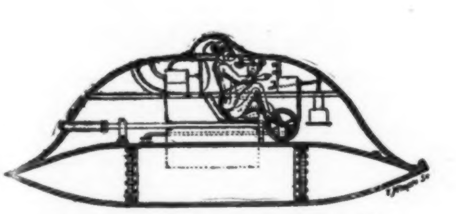
LAGANNE. French (1881).

The "Submersible." Length, 92 feet; width, 10 feet; height, 13 feet; propulsion by a steam engine; constructed of steel; provided with a torpedo tube. *A*, steam generator; *B*, float; *D*, torpedo tube; *M*, conning tower; *N*, ladder; *T*, torpedo.



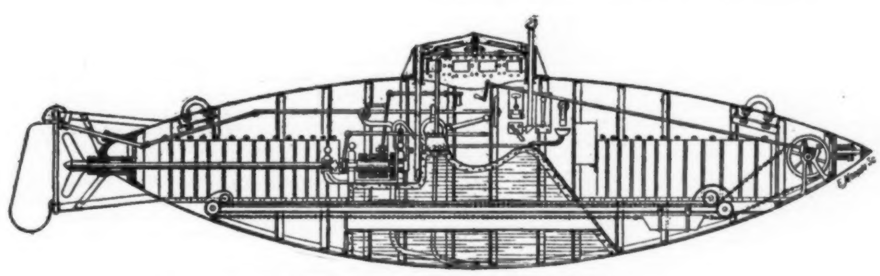
LAKE. American (1896).

The "Argonaut." Length, 52·5 feet; diameter, 14·75 feet; propulsion by a screw actuated by a steam engine while afloat and wheels driven by an electric motor when submerged; submersion through a reservoir of water; emersion through a counterpoise; constructed of steel.



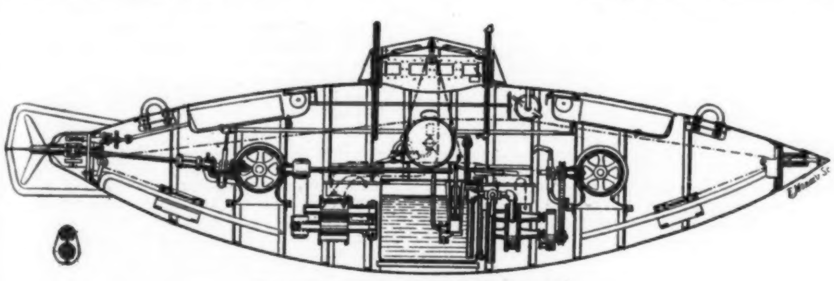
DRZEWIECKI, No. 1. Russian (1877).

Length, 16·5 feet; propulsion by means of pedals; submersion through the introduction of water.



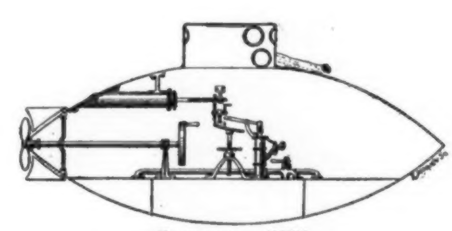
DRZEWIECKI, No. 2. Russian (1879).

Length, 46 feet; diameter, 10·5 feet; propulsion by a screw actuated by winches; submersion through a reservoir of water and two counterpoises that move from stern to stem, or reciprocally; provided with a conning turret.



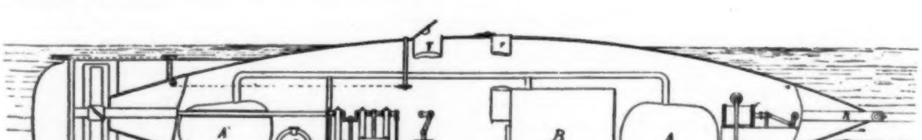
DRZEWIECKI, No. 3. Russian (1884).

Length, 46 feet; diameter, 10·5 feet; propulsion by an electric motor; submersion through a reservoir of water and counterpoises as in model No. 2.



GARRETT. (1875).

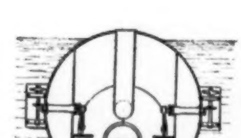
Length, 13·75 feet; diameter, 5 feet; propulsion by a screw and gas motor; submersion through a diminution of volume.



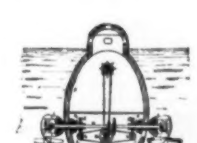
NORDENFELT. Swedish (1885).

Length, 64 feet; tonnage, 60 tons; propulsion by a steam engine while afloat and through superheated water while submerged; submersion through two lateral vertical screws and a rudder regulated by a pendulum, *W*; constructed of steel.

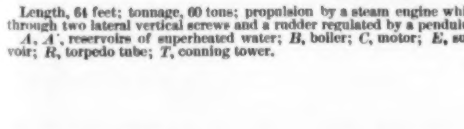
A, *A'*, reservoirs of superheated water; *B*, boiler; *C*, motor; *E*, submersion pump; *c*, submersion screw motors; *F*, chimney; *K*, reservoir; *R*, torpedo tube; *T*, conning tower.



Transverse section Nordenfelt submarine boat.

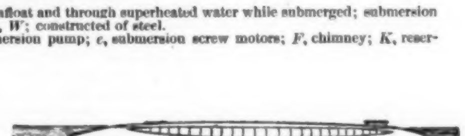


Transverse section Baker submarine boat.



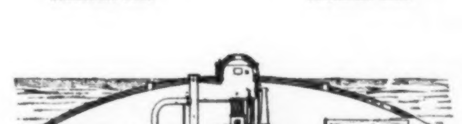
CAMPBELL AND ASH. English (1885).

Length, 34·5 feet; diameter, 8·25 feet; propulsion by two screws and an electric motor; submersion through a reduction of volume.



LECAUDEY. French (1887).

Length, 63 feet; diameter, 16·5 feet; propulsion by a screw and a motor of unknown character; submerged by a horizontal rudder.



BAKER. American (1892).

Length, 46 feet; width, 9 feet; height, 13 feet; tonnage, 20 tons; propulsion by steam while afloat and electricity while submerged; submersion by screws.

submarine boat possessed, in a rudimentary state, all the parts that have been used by the inventors who have succeeded him and who have been better favored through the progress of mechanics. The "Turtle" had a submersion reservoir, submersion and emersion pumps, with double valves, a safety weight, a compass and level-tube, a submersion cock placed under the pilot's foot, and air ports closed with cut-offs. It even had an ingenious arrangement for screwing to the side of a hostile vessel a torpedo, the explosion of which was regulated by a clockwork movement. The "Tortoise" never blew up any ship, however. In 1776, manned by Sergeant Lee, it did indeed attack an English vessel, but the latter was sheathed with copper, and, for want of an adequate bearing point, the screw did not pierce the metal. Sergeant Lee had to abandon his torpedo, which an hour afterward exploded and raised a large column of water, much to the amazement of the English crew, which was unconscious of the danger that it had run.

The celebrated mechanic Fulton, who also was an American, follows Bushnell chronologically upon the list of the inventors of submarine boats. As is well known, it was in France that he constructed and experimented with the "Nautilus." He had presented a preliminary project to the Directory in 1797, but it was not until June, 1801, that the trials of his cigar-shaped boat, 21 feet in length and 6·5 in width, and built of iron and copper, took place upon the Seine in front of the Invalides. The boat, which was provided with a mast, moved by sail while afloat. In order to submerge it, the sail and rigging were folded, and the mast was turned back and laid in a groove. Propulsion was assured under water by means of a sort of paddle-wheel actuated through winches turned by the crew.

The experiment upon the Seine having proved satisfactory, the "Nautilus" was sent to Brest. Manned by the inventor and three assistants, it descended in the roadstead to a depth of 25 feet, and evoluted in all directions for an hour. It even succeeded in blowing up an old hulk put at Fulton's disposal by the commission. On August 7, 1801, Fulton, having carried along air under pressure, remained submerged for nearly five hours. This was his last submergence in France. Despite these interesting results, the French government did not judge it well to occupy itself any longer with submarine navigation. In 1804 Fulton crossed over to England, where he was no more fortunate. He then returned to the United States. So Bushnell, one hundred and twenty-five years ago, and Fulton, one hundred years ago, succeeded in experiments which, it may be said, were just as conclusive as the most recent trials of our large electric submarine boats. It might seem as if there remained very little to do in order to triumph definitively over the difficulties of submarine navigation. Nevertheless, for the last three-quarters of this century things have been in statu quo.

The third submarine boat which we figure dates back to 1851, and is that of Phillip. From Fulton to Phillip, in this fifty years' interval, attempts had been made but rarely. Among these may be cited, as a matter of curiosity, the Montgeny submarine boat (1833), which must have been actuated by a powder motor. The submarine boat of Phillip, the American tailor, is slumbering along with its inventor at the bottom of Lake Erie. It had previously furnished several satisfactory experiments.

Upon the whole, the history of submarine navigation may be divided into three periods. The first is that of Bushnell and Fulton, characterized by the simplicity of the mechanical methods employed and by positive results. The second begins with Althabegoity, Riou, and others, and extends up to recent years. The third comprises the "Holland," "Goubet," "Gustave Zédé," "Morse," and the still newer types that are constructing or are under study.

(To be continued.)

CARE OF ASPHALT STREETS IN GERMANY.

THE treatment of asphalt streets here in Breslau is entirely different from methods employed in the United States, says United States Consul Erdman, of Breslau.

For instance: One man has charge of four squares in front of the consulate. His tools for keeping the streets clean are as follows: An iron-hopper wheelbarrow, a shovel, a broom, and a rubber scraper about 3½ feet long. The rubber is fastened in a vise-like wooden clamp and is about 4 inches wide, one-quarter of an inch thick, and very stiff. This man during the day is continually going over his four squares, taking up the litter and keeping the streets thoroughly clean. Early in the morning, after having cleaned the street, he takes his wheelbarrow, loaded with very fine, sharp sand, and scatters the same with his hands or a small shovel lightly over the streets, to prevent slipping. Should it be a rainy day, he repeats this process several times during the day. Once a week, two sprinkling cars are sent out alongside of each other, so that they cover the whole street at one time with water, washing the same thoroughly. Immediately following the sprinkling cars come four one-horse roller brush sweepers, about 2 feet in diameter, sweeping the water, slime, etc., into the gutter, when the same is piled up and carted away. Then the man who has charge of those streets comes along with his wheelbarrow and sprinkles sand all over the street. In spring or autumn, when the streets are often sloppy or wet, the washing is done several times during the week.

Mr. Erdman is informed the washing is done for the purpose of removing the slime which the asphalt seems to leave, and to keep the street from being slippery; also for the perservation and hardening of the asphalt.

The man who has charge of the asphalt streets is paid 22 pfennigs (5 cents) per hour. Ordinary street hands are also paid per hour and receive 18 pfennigs (4 cents).

All streets are kept in excellent condition, the shopkeepers or tenants not being permitted to put sweepings on the pavement or street. These must be taken up and put in a box kept for that purpose.

The city has wire baskets fastened on lamp-posts against houses, fences or trees, in which the public may throw waste paper while walking along. It is very rare to see any waste paper on the streets, as the citizens in general take pride in keeping the streets clean. The householders have to sweep the streets to the center of the street regularly every morning before six o'clock. The litter is piled up and carted away by the city teams.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Port Works at Montevideo.—Minister Finch writes from Montevideo, under date of March 28, 1899, that there appears to be an opening for United States enterprise in the construction of the port at that place. The cost of the work is estimated by Mr. Finch at from \$8,000,000 to \$10,000,000. Representatives of English, German, and French firms are endeavoring to obtain the contract, but bids from the United States are desired. Those wishing to bid should write to Mr. Finch in detail.

Exports of Cheese and Candles to the Philippines and West Indies.—Since Cuba, Puerto Rico, and the Philippines have come under the régime of the United States, there have been exported from this consular district, says Consul S. Listoe, of Rotterdam, to these new possessions large quantities of cheese and candles. During the past six months (October 1 to March 31) there have been issued at this consulate and the agency at Schiedam two hundred and thirty-eight invoices for the islands named, and, with the exception of a few shipments of gin, these invoices have mostly covered shipments of cheese and candles. To Cuba there have been shipped 514,974 pounds of cheese and 44,000 pounds of candles; and to Puerto Rico 121,682 pounds of cheese and 435,188 pounds of candles. To Manila a considerable quantity of these two articles has also been shipped, but the exact amount cannot be ascertained, as invoices for the Philippines are not always taken out, merchants here claiming it is unnecessary.

The cheese has principally been of the "Edam" and "Gouda" varieties, and the candles mostly the ordinary stearin articles for domestic use.

I report these facts for the reason that I know that cheese very much resembling the varieties named is made in the United States, and it appears to me there might be a chance for American cheese and candle manufacturers to find a market for their products in the islands. There might perhaps also be a chance for enterprising Americans to establish dairies and cheese factories there. In Puerto Rico and some parts of Cuba there is reported to be plenty of fine and nourishing grass and other food for cattle; and even if there should be certain obstacles for the dairyman to overcome on account of the climate, I have no doubt that American enterprise will be equal to the task. There is no reason why Americans should not supply the West Indian Islands and the Philippines with cheese and various articles which are now imported from the Netherlands and other European countries.

Fig Cultivation in Greece.—American fruit growers have informed me that in certain portions of the United States they have succeeded in raising fig trees of healthy appearance, which bear an abundance of fruit; but that, for some reason unknown to them, the figs do not mature so that they can be dried and packed for the market. I have made inquiries, says Consul Daniel E. McGinley, at Athens, in regard to the Greek method of fig culture, and a well informed resident of Athens, Mr. George Nicolaides, has favored me with the following paper on the subject.

While waiting for wild fig trees to grow and bear in the United States, growers might profit by importing the wild fig and fastening it to their trees at ripening time.

"Wild fig trees are found both in Greece and in Asia Minor. The fig tree which produces the famous sweet fruit was well known in ancient Greece, and very probably was cultivated in the same manner as at present. Herodotus says:

"'In the plain of Babylon one finds date trees everywhere, the majority of which produce fruit; and these trees are cultivated in the same way as the trees are cultivated in Greece, viz., by hanging on the trees bearing edible dates the fruit of the date trees of the masculine kind, as the Greeks say, which trees do not produce dates, so that the insect which comes out of the fruit of the masculine tree may inoculate the fruit of the tree bearing dates, and thus prevent it from falling before ripening.'

"In all parts of Greece where figs are grown, from May to June, the cultivator tries to procure fruit from the wild fig tree. Last year, the wild fig trees of Smyrna not producing a sufficient quantity for local needs, the proprietors of plantations were obliged to buy the necessary fruit from the isles of the Greek archipelago and even from Crete, paying a very high price.

"Wild figs are ill-shaped, rather hard, and dry. They are strung in bunches of ten on a piece of strong cord or rope, and are fastened on the sweet-fig trees.

"This method is not universally adopted. In Tuscany, for instance, it is never employed. Perhaps the wild fig trees there multiply to such an extent that the insects can pass to the other trees unaided. On the other hand, a practice followed with persistence for more than twenty-five centuries ought not to be disregarded. The opinion that the wild fig tree may by cultivation be made to produce edible fruit is erroneous. In Greece, this tree has existed during centuries in proximity to cultivated fig trees, but has not in the least changed its nature.

"It would seem advisable to introduce the wild fig tree into California, and to try the method in vogue here."

The Fair of Nizhni Novgorod.—Nizhni Novgorod is situated on a high cliff, at the confluence of the Volga and Oka Rivers, says United States Consul Thomas Smith, of Moscow. The present population of the city is about 95,000. The lower part was inhabited by a colony of Tartars in 1222. The distance from Moscow by rail is 227 miles; it can also be reached by steamer from Resan by the River Oka, and from the Caspian Sea by the Volga. A fleet of about four hundred and fifty steamers, besides a large number of tugs and tow-boats, ply on the river. The Volga is some 1,250 miles in length.

The fair opens on the 27th of July, but business proper commences about the 12th of August and lasts until the 6th of September. It is attended by nearly half a million people from both European and Oriental Russia, and the amount of business generally transacted is estimated at about \$35,000,000.

The fair is held in and around a place called the Bazar, composed of about sixty streets, on which are only stores and warehouses. The following goods are sold: Cottons, prints, carpets, cloths, linen, flannels, silks, lace, bags of jute and hemp, leather, skins, chamois, furs, paper, copper, cast iron, enameled ware, cutlery, agricultural implements, implements for mechanical and other industries, seed for farmers, oats, corn, wines, spirits, paints, varnish, lime, cement, etc., all of which are chiefly of Russian origin. Sheet iron, boiler plates, copper, precious stones, and a variety of geological specimens from Siberia are also exhibited, as well as cotton in a raw state from Central Asia and Persia, and turquoises, silks, and silverware, made in Oriental style, from Persia, Bokhara, Taschent, etc.

The fair is well managed, the governor of Nizhni staying there during the time it is open. He has a military staff, and the discipline is very strict. The merchants have their own committee, before which everything concerning trade is laid. On the fair grounds, there are hotels, churches, dining saloons, theaters, and Tartar and Chinese quarters. There is good sewerage and waterworks, and the place is surrounded by a canal of water as a protection against fire. There is very little trade done in goods imported from abroad. The fair, for the last few years, has been losing its prestige on account of the number of railways that have been built in European Russia and central Asia, and the great Siberian line, which is more than half finished. The passenger tariff has also been reduced to one-third of what it was formerly, so that merchants can now come to central towns, where everything is manufactured and kept in large stocks all the year round, to get what they require; thus, the fair is now visited mostly by Russian and Asiatic tribes. Large cities and towns in central Russia keep stocks of foreign goods, which are bought partly abroad and partly at the fair.

Some three months before the commencement of the fair, notices are inserted in the papers stating the stores that are to be let, giving all particulars and where to apply. The rents of the stores range from \$100 to \$1,450; but, in addition to this, there are taxes for the police, city, and other purposes, which amount to about 5 per cent. on the rent.

It must be understood that the word "fair" does not signify an exhibition, but a large market where goods are exposed for sale and yearly contracts concluded.

Salmon Canneries in British Columbia.—Consul Dudley, of Vancouver, under date of April 12, 1899, writes that a meeting has been held by the salmon canners of the Province to protest against the new regulations established by the government of the Dominion, regarding the catching and canning of salmon. Incidentally, the assembly urged that the canners be allowed to purchase salmon caught in American waters, and to bring them into British Columbia free of duty. The establishment of additional hatcheries on the Fraser River, says the consul, will increase the run of salmon along the northern shore of the State of Washington. He adds:

Most of the fresh fish retailed in this city is imported from the United States. The reason given for this is that the wholesale dealer can there procure any quantity of the kind of fish desired, while the business in the Province is not sufficiently organized to insure the variety needed.

Klondike Output for 1899.—Under date of April 29, 1899, Consul Brush, of Clifton, says: An authority whose estimates have heretofore proved conservative, brings word from Dawson that the wash-up from the Yukon this year will aggregate \$19,000,000, apportioned as follows: Eldorado, \$2,500,000; Bonanza, \$2,500,000; French Hill, \$1,500,000; Gold Hill, \$1,500 000; Big Skukum, \$1,000,000; Little Skukum, \$1,000,000; Dominion, \$4,000,000; Hunker and Quartz, \$5,000,000; total, \$19,000,000. These figures leave out of consideration a number of important locations, including Sulphur Creek, Stewart River, Upper Klondike, and Scroggie Creek.

Canadian Ocean Traffic.—Consul Brush writes from Clifton, April 29, 1899: Urgent appeals are being made to the Canadian government for improvements on the St. Lawrence River and gulf. The heavy losses in both the past few years have led the insurance companies to double their rates, the new schedule taking effect immediately. The high rates of insurance and the dangers of the route are diverting considerable ocean traffic to American ports, and further loss of traffic is imminent, unless the government takes immediate steps to widen the channel through Lake St. Peter and establish new lighthouses in the gulf.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

ENGINEERING NOTES.

The recent investigation of the automatic coupler question by the English Board of Trade has been influential in starting agitation along the same lines in Germany. Friends of the cause point out that in the fiscal year ending in 1897 the list of accidents on Prussian railways included 264 employés killed and 667 injured.

In Jersey City, the sprinkling of many of the streets is being done by trolley cars, the company sprinkling the streets with water supplied by the city at cost price. The cost at this rate will average about six cents a lineal mile. There are 24 miles of streets to be sprinkled daily by the North Jersey City Street Railway Company.

The bridge over the river Indus, at Kotri, is approaching completion, $3\frac{1}{2}$ lakhs more having to be spent; its total cost will be something over 31 lakhs. The bridge consists of one span of 100 feet and five spans of 350 feet, the girders being carried on brick piers 35 feet high founded on wells 50 feet to 60 feet deep, sunk to rock.

A few weeks ago Mr. M'Leod Stewart, ex-mayor of Ottawa, addressed the members of the Liverpool Chamber of Commerce on the proposed Canadian ship canal. The scheme is one to complete and develop communication by water between the Georgian Bay of Lake Huron and Montreal, a distance of 430 miles, so as to make it practicable for vessels of large size to pass between these points without traversing Lakes Erie and Ontario, and thus to shorten the passage by a thousand miles.

The largest steam engine that has ever been built in Greece is now under construction by one of the principal firms of the Piræus for a ship belonging to the Panhellenic Steamship Company. The engine is designed to indicate 820 horse power. From Mr. Consul Walsh's report on the trade of the Piræus and district in 1898 we learn that there is a steady advance in the shipbuilding and engineering trades at that port. In the case of a mill which is now being built for the manufacture of paper wrappers, the machinery has been ordered from Germany, with the exception of the steam engine of about 100 horse power and boilers, which are to be constructed in the Piræus.—The Engineer.

A new dry dock is being constructed at the Newport News Shipbuilding Company's yard, which, it is said, will be the largest in the world. The dimensions of the new dock are: Length on top, 827 feet; length inside the caisson, 806 feet; breadth on bottom, 80 feet; breadth at top, 162 feet. The entrance will be constructed so as to admit any vessel that can be accommodated inside the dock. The depth over the sill will be 30 feet at mean high water; mean range of the tide, 2 feet 6 inches. The entrance abutments will be constructed of concrete lined with granite. The bottom of the dock will be of concrete overpiling. The interior will be constructed of timber. The caisson will be constructed of steel, and it will be operated with trimming tanks, so arranged that it will never be necessary to pump out the water ballast, as is done with all docks previously constructed in the United States. The pumping plant has been designed to empty the dock in two hours, which is at the rate of about 200,000 gallons per minute. It is said that the cost of a masonry dock would be three times as much as of that described.

Mr. J. R. Cravath has been discussing the question of the best speed time curves in rapid transit. He points out that electrically-driven tramcars may start and suddenly run up to a high speed and be allowed to drift or float into the next station; started rapidly up to a lower speed, maintained there until the next station is almost reached, and suddenly stopped; or started slowly, brought up to a high speed, and suddenly stopped. In rapid transit a short delay of the cars means an accumulation of passengers and a greater load with a shorter time to carry it. This increased duty in the cars means a higher power equipment than is required under ordinary conditions. Maximum speed is attained between two stations by pushing the acceleration up to the instant that the brakes must be applied. In the case where there is shorter time to perform the journey, it is best to obtain the speed by accelerating as rapidly as possible, loading the motors to their full capacity up to a speed below the emergency work, and allowing the train to float with the power turned off into the next station. The best conditions are obtained by installing motors that will meet the emergency work with full power turned on until the brakes are applied.

The diversion of engineering business, such as the building of locomotives and steel bridges, from Great Britain to the United States is provoking an animated discussion in the English press. One of the most significant letters published comes from Mr. Thomas H. Robinson, editor of Fairplay, who declares that the loss of trade is due chiefly to the logical effect of trade unionism. He says: "When our leading engineering firms are full of work for the next two years, as is the case with most of them, they cannot be accused of want of enterprise, for they have already undertaken more than they can do. When the men can earn in four days as much as will keep them for a week, I do not see why they should be blamed for not doing more. They are not philanthropists, and it is only in poetry that manual labor is a joy; while as to commercial travelers, what is the use of their hunting up orders which they know cannot be executed? The real cause of the trouble lies in another direction, namely, in the restriction of apprentices imposed by the trade unions. Some ten years ago a prominent shipbuilder and engineer on the Clyde told me that in consequence of these restrictions we were approaching the time when there would not be a sufficient number of skilled hands to meet the requirements of trade. That time has come. If our engineers were to double their works to-morrow, they could not find suitable men to fill them, because such men do not exist, and under trade union rules can never be brought into existence. The object of trade unions is not to increase trade, but to limit the number of men employed in any particular industry, and this object they have attained with the result we see."

ELECTRICAL NOTES.

M. E. Hospitalier has been giving the particulars of the Fulmen cell used in some of the electrical cabs in Paris. They have six positive plates, having 135 grains of lead and 340 grains of paste each, and seven negative plates, having 135 grains of lead and 255 grains of paste each; there are 21 square decimeters of positive plate. The total weight of the accumulators and liquids is $7\frac{1}{4}$ kilogrammes. Normal discharge 21 amperes for 5 hours, with a mean voltage 1·9.

Popularity has already been achieved by the electric cabs, which recently began to ply for hire in Paris. The trouble is there are not yet enough to go round. A dozen came out from the Compagnie des Petites Voitures depot on Easter Sunday, and the number has steadily increased every day. The company has a hundred available, which will be on trial for a whole month. They are all moved by electricity. The type at present is the so-called landaulet, carrying four passengers. The fares are very moderate, only a trifle above the regular thirty cents per journey. All this made the cabs instantly popular.—Electrical World.

Illuminating shells for lighting areas of ocean in life-saving work or to get the range of the vessels of an enemy are proposed by an American company, says Engineering News. The shell used is a hollow cylinder made of steel tubing, and charged with calcium carbide, which coming into contact with water generates acetylene gas. The end of the shell remains above water, and at this end are burners lighted by an electric device contained in the shell. It is claimed that the light produced is of 1,000 candle power, and cannot be extinguished by water. The shell is to be shot from a gun to the distance of two miles, and floats with one-quarter of its length above water.

An electrical siren has been devised and is said to have been perfected at Ottawa, Canada. It is stated that this siren may take the place of electric bells, and may come into general use for fog signals at sea and along the shores where such signals are now in use. The siren can be placed at a point inaccessible to the ordinary steam plant now used in fog-signaling and can be operated by wires connecting the power at almost any distance. The sound is produced by the vibration of a diaphragm at the base of a horn. This siren, it is expected, will be adopted by the Dominion government to take the place of the rather cumbersome steam plant required for signaling stations.

A heavy motor truck for freight work in city streets has been built by the Fischer Equipment Company, of Chicago, on the general principle hitherto developed in the Patton motor car. Power is derived from a 3-cylinder 8 horse power vertical gasoline engine located in the forward part of the truck under the driver's seat; this is direct coupled to a dynamo which charges a battery of 40 cells of 144 ampere hours capacity. The dynamo and storage battery in turn supply the two 5 horse power motors geared to the rear wheels. The engine is kept in continuous operation while on the road, charging the battery when the motors take a small current or none at all, supplying the motors direct when the load is moderate, and being helped out by the battery at times of heavy load. The weight of the truck is 9,000 pounds.—American Electrician.

The progress of electric traction in the vertical direction has been referred to again and again in our columns, but in England the absence of exceedingly high buildings, and the great development of hydraulic power, has prevented the great increase in electric lifts which is characteristic of American towns. Some interesting figures in this respect were recently given by Mr. R. P. Bolton, the electrical engineer, of New York. In our contemporary, The Electrical World, Mr. Bolton estimates that in New York the vertical travel by electric elevators in the southern end of the island below Canal Street was at least 150 miles in every day of 10 hours. The elevator travel might easily run up to 1,000,000 people a day for the city. There were 60 down-town skyscrapers alone, and each of these had a travel of from 5,000 to 15,000 passengers daily—i. e., 2,500 to 7,500 up and down. This feature of travel is often overlooked in estimating the movement of population.

Although electric power is used to a large extent in Sweden, where the numerous large waterfalls afford exceptional opportunities for cheap generation of electric power, electric railways are, as yet, but few and of no great importance. One reason for this is probably the slowness with which the authorities appear to work, important applications for concessions for electric railways handed in in 1896 and 1897 still remaining undecided. The gage of various electric railways under contemplation varies materially, but overhead wire is the system usually advocated. At various large private concerns, more especially sawmills, smaller electric railways have been built, and they give every satisfaction, and there is every reason to believe that electric traction will be adopted at numerous railways of more modest dimensions, as is also the case in Germany. In this latter country not only on many small railways and tramways is electric traction being substituted for other modes of traction, but in the building of new lines preference is being given to electricity.

The United States consul at Osaka says that the manufacturers of electrical apparatus in the United States control the Japanese market. Electrical engines are imported from the United States, and they are giving general satisfaction. Telegraphic machinery was imported into Japan during 1897 as follows:

United States	$2,301
Great Britain	1,102
Germany	691

But little came from any other country. The Japanese government owns both the telegraph and telephone service. It is said that considerable delay has frequently occurred in the execution of orders from Japan for electrical machinery in Europe, and that, in consequence, the American market has been given the preference, with the result that the superiority of such machinery has been fully established. The more direct communication between the United States and Japan, together with the lowering of overland freights, should stimulate manufacturers of machinery to increased effort for this market.

SELECTED FORMULÆ.

Rubber Stamps for Blue Printing.—C. F. Jenkins, writing for Home Study Magazine, says: "Almost every engineer or architect has a business card on a rubber stamp, but has found that the impression made by it on the tracing is useless for purposes of reproduction on a blue print. Here is the method I have been using for some years to overcome this defect: The impression of the stamp is made upon the tracing linen, and, while the ink is still moist, it is dusted over with lampblack, soot, or the like, with a tuft of cotton. The ink takes up the pigment, which is actinically impenetrable, and the impression washes out splendidly on the blue print. All draughtsmen will appreciate the saving of time this little wrinkle permits."

Red Ink:

1. Carmine, No. 40	30 grains.
Ammonia water	1 drachm.
Acacia	6 grains.
Water, q. s. to	1 ounce.

Dissolve the carmine in the ammonia, and add the other ingredients. The depth of tint may be varied by the use of more or less water.

2. Half a drachm of powdered drop lake and 18 grains powdered gum arabic, dissolved in 3 ounces ammonia water, make one of the finest of carmine inks.

3. The Era Formulary is authority for this one: Rub 6 parts of red carmine with 75 parts of liquid water glass. Dilute this mixture with 675 parts rain water. Let it stand a few days, and pour off the fluid.

Scarlet Ink for Steel Pens.

4. Anilin ecrimson	1 ounce.
Water	1 gallon.

5. Lehner's "Manufacture of Ink" gives this formula for a red fuchsine ink:

Fuchsine	2 parts.
Gum arabic	5 "
Alcohol	10 "
Water	100 "

Pour the alcohol, 90 per cent., over the finely rubbed fuchsine and effect complete solution by gently heating. Dissolve the gum arabic by itself in the water, strain the solution, and heat to boiling. Into the boiling solution pour the fuchsine solution in a thin jet, stirring constantly.—Pharmaceutical Era.

Shoe Blacking Paste.—The following makes a brilliant and excellent blacking:

Ivory black	40 parts.
Sulphuric acid	10 "
Fish oil	10 "
Sodium carbonate, crystallized	18 "
Sugar or molasses	20 "
Liquid glue, prepared as below	20 "
Water sufficient.	

Soak 10 parts of good white glue in 40 parts of cold water for four hours, then melt with a gentle heat. Then for every 80 ounces of the liquid glue add 3 ounces of glycerin (or in the same proportion). Set aside. Dissolve the sodium carbonate in sufficient water to make a saturated solution in the cold (it will take about 3 parts of water at 60° F.), and set aside. Next, in an earthenware vessel moisten the ivory black with a very little water, stirring it about with a wooden stick, and add the sulphuric acid, agitating the mixture until a thick paste or dough is obtained. Next add the fish oil (any kind of animal, or even colza oil will answer, but it is best to avoid high-smelling oils), and incorporate by agitation, adding, a little at a time, sufficient of the saturated solution of sodium carbonate to cause effervescence, but not enough to liquefy the mass. Stir until effervescence ceases, then add the molasses, or sugar, according as you want a soft, damp paste, or a drier one, and, finally, add a little at a time, under constant stirring, sufficient of the glue solution to make the paste of the desired stickiness. The exact amount of the latter ingredient necessary must be learned by a little experience. It is, however, a most important item, as it gives the blacking a depth and brilliancy that it otherwise could not have (and in which most of the blackings on the market are sadly deficient). Besides this, it renders the blacking dampproof, and, at the same time, keeps the leather soft and supple.—National Druggist.

Laundry Polish.—1. Melt 5 parts of stearic acid, add 5 parts of absolute alcohol, and triturate the mixture with 95 parts of wheat starch. Starch prepared with this mixture takes easily a fine polish. The polishing irons should be thoroughly cleaned immediately after use.

2. Spermaceti	$1\frac{1}{4}$ ounces.
Gum arabic	$1\frac{3}{4}$ "
Borax	$1\frac{3}{4}$ "
Glycerin	$4\frac{1}{2}$ "
Distilled water	$1\frac{1}{2}$ pints.

If desired to use with starch, mix $4\frac{1}{2}$ teaspoonfuls with $4\frac{1}{2}$ ounces of boiling starch.

3. White wax	2 ounces.
Spermaceti	4 "
Stearin	$\frac{1}{2}$ "
Ultramarine blue	3 grains.

Melt together and let cool.

For doing up a dozen shirts, put a piece the size of a hazelnut in the hot starch and mix. Finish with a hot iron the usual way.—Pharmaceutical Era.

Blackberry Cordial.—

Ripe blackberries	1 pint.
Blackberry root	1 ounce av.
Mace	60 grains.
Cloves	60 "
Allspice	60 "
Cassia	60 "
Ginger	60 "
Port wine	4 fluid ounces.
Alcohol	2 " "
Water	q. s.

Express the juice from the berries and add sufficient water through the residue to make the expressed liquid measure 12 fluid ounces; add the alcohol and wine. Mix the drugs and reduce to medium fine powder, moisten with the expressed liquid, pack lightly in a percolator, macerate for twenty-four hours, percolate, and if the percolate is less than 16 fluid ounces, add enough menstruum consisting of one part of alcohol and four parts of water to make up the measure.—Meyer Bros. Druggist.

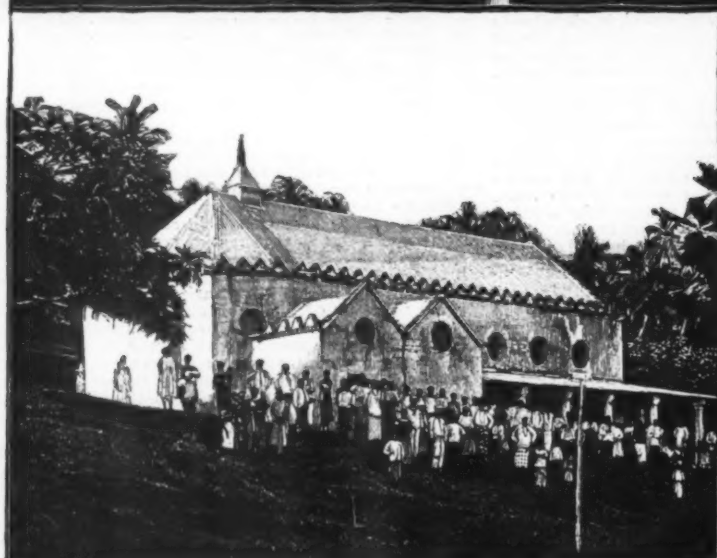
SAMOA'S LATEST TROUBLES.

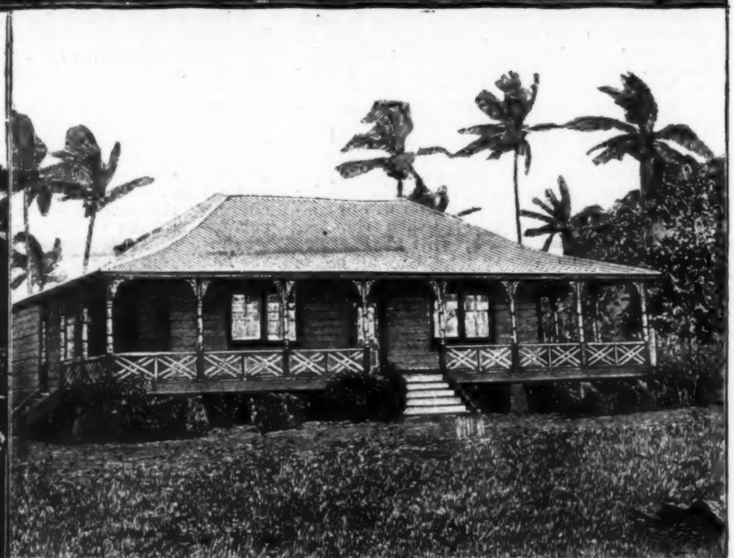
ANY one who supposes for a moment that interest in Samoa has abated is not alive to the importance of events in that quarter. News comes through slowly, owing to the want of a means of telegraphic communication, and on this account the gravity of the outbreak

Natives of Matupi.

Climbing a Cocoa Palm.

A Native Hut in Apia.





The French Mission-Church in Apia.
Samoan Women Making Bread.

House of King Malietoa near Apia.
German Sailors in Matupi Filling Shells.

SCENES FROM SAMOA.

is overlooked. But Germany considers the state of affairs serious enough to justify her dispatching the cruiser "Gefion" from her Chinese squadron. The commission, upon whose presence the peace lovers count so much, is on the way to Samoa, and the present situation, from all points of view, is full of interest.

For such a small portion of the globe, Samoa has proved herself capable of causing considerable dissension and jealously among the big nations who guard or break the peace of the world. The intrigues of the representatives of the various peoples interested in the islands led to the necessity for some sort of an understanding as far back as 1884, when Germany and Great Britain agreed to respect the independence of the islands; and, in 1890, an agreement between the United States, Great Britain, and Germany was ratified at Berlin, by which it was believed all contentions would be settled for good through the recognition of a native chief who was agreeable to all parties and the establishment of an international court to be presided over by a judge appointed by the King of Sweden, to which disputes between resident foreigners were to be referred.

Under these new conditions Samoa seemed to be so peaceful and safe a spot that the famous author Stevenson, when consumption had placed a close limit on his life, chose the island as a quiet place in which to wait for death. But somehow the natives of the volcanic island seemed to have a dislike for a quiet life, and were always either on the edge of an outbreak or in actual conflict. The cause of the present trouble will be interpreted differently according to the nationality of the interpreter, but from a correspondent who recently passed through Samoa on his way home the true and unprejudiced account of the origin of the

trouble arises from the Germans having illegally deposed the late King Malietoa Laupepa in 1887. When he returned from exile in 1889, he found that Mataafa, the high chief, had defeated Tamasese, the German nominee, and was in authority. The Berlin negotiations ended, however, in the reinstatement of Malietoa, who had displayed no eagerness to resume the reign of power, and the exclusion of Mataafa. The chief, in high dudgeon, thereupon retired to Malie and, becoming a menace to the peace of the islands, was declared a rebel, and, after some fighting, surrendered with his chiefs on board the "Katoomba," in 1893. From that time forward there was peace, but the Germans had taken Mataafa into favor, and, when Malietoa Laupepa died, in August, 1898, they supported him in his resolve to contest the authority of Malietoa Tanu, the nominee of Great Britain and the United States.

The Germans in the municipality were exasperated at the dismissal of Mataafa, whose accession to power they knew would give them valuable concessions. The situation rapidly grew dangerous, and parties were landed from the "Porpoise" to protect the houses of the British consul and Chief Justice Chambers, an American subject, who, in virtue of his authority, had given judgment in favor of Malietoa Tanu. Hostilities broke out in January, and many were killed, the king elect and his chiefs being compelled to take refuge on board the "Porpoise."

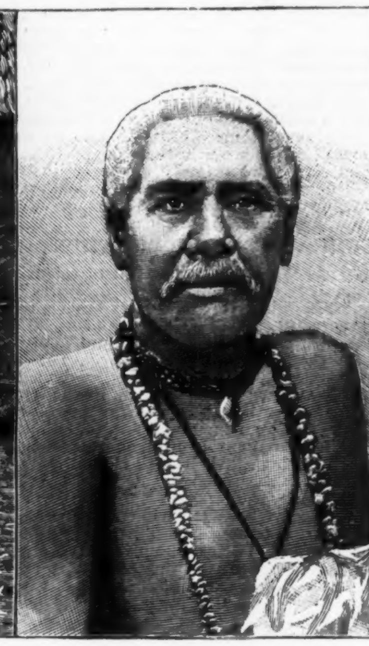
Our correspondent, on arriving at Samoa, sought an interview with old Mataafa, in his temporary triumph, to learn his views on the situation. The chief was sleeping at the time, but one of the very stout ladies of his court, attired mostly in a tappa mat, introduced the visitor. Mataafa was all smiles and greatly relished a cigar, and the interview was conducted, smiling and in dumb show, for a quarter of an hour. An interpreter then appeared, and the visitor explained that he had arrived from Ceylon, having taken part in a great battle in the Soudan, and was on his way round the world, and wished to learn which power his highness considered would best protect the interests of Samoa. Mataafa, who had tasted the bitterness of the frowns and smiles of Germany, shook his head, considered for a time, and, having ascertained that his visitor was an Englishman, exclaimed in the best English he could command: "All same—like one—like all." Beyond this safe utterance the chief would not go, and our correspondent left, having received permission to take the portrait of Mataafa, which we give. He departed with a very pleasant impression of the old man, and with the conviction that joint control was not the best form of protection for these beautiful islands.

It was in the middle of March that the bombardment of the rebel stronghold began. Admiral Kautz, of the United States navy, who, with his flag flying on board the "Philadelphia," was the senior naval officer present, had called a meeting of the consuls and chiefs together to discuss the situation. It was resolved to dismiss the provisional government, and a proclamation was issued directing the chiefs of the Mataafa section to return to their homes. This proclamation was answered by the Mataafans attacking the Malietoans. The United States cruiser "Philadelphia" and the British cruisers "Royalist" and "Porpoise" then opened fire and shelled the rebel position.

The situation at present is this: The rebel Samoans seem for the time being to have had enough of fighting with men armed with the weapons of the British and Americans, and are lying low awaiting developments, which, if they are expected to come through the allied sailors and marines attacking the natives, will be a long time coming, for the commission appointed by Germany, the United States and Great Britain, to go to Samoa and try to bring about an amicable understanding, is now on the way there, and, being clothed with unlimited authority to take entire charge of affairs on the islands, it is pretty safe to predict that with their presence the aspect of affairs will change radically, for they are a trio of trained diplomats and are men who will speedily take the authority out of the hands of the little men of the islands, who, under the impression that they are engaged in running the universe, have done more to foment trouble than all the natives put together. Our own Admiral Kautz has kept a firm hand on the situation and has proved himself quite capable, as he expressed it in a letter that has aroused much criticism on account of its outspoken tone, of "bossing the ranch."

The most significant feature of the entire affair, in the opinion of many, is that for the first time American and British sailors and marines fought shoulder to shoulder, a realization of the dream of those who favor an alliance offensive and defensive between the two

MALIETOA SURROUNDED BY HIS GUARD



MATAAFA.

A PARTY OF MATAAFA'S WARRIORS.

great nations that caused intense enthusiasm in certain quarters and drew from the Earl of Selford, Under-Secretary of State for the British Colonies, the following burst of eloquence:

"Now the dark, miserable cloud which so long hung over the Anglo-Saxon people has drifted off. It is only a few days since British and American officers and men fell on the same field of conquest. They were not engaged in fratricidal strife, but were fighting shoulder to shoulder, and, small though the incident was, it will be of importance in the history of the world."

The islands are for the most part lofty and broken and rugged in appearance, rising in some cases to upward of 2,500 feet in height, and covered with the richest vegetation. The soil, formed chiefly by the decomposition of volcanic rock, is rich, and the climate is moist. The forests, which include the bread fruit, the cocoanut, banana, and palm trees, are remarkably thick. The orange, lemon, tacca (from which a kind of sago is made), coffee, sweet potatoes, pineapples, yams, nutmeg, wild sugar cane, and many other important plants grow luxuriantly. Until recently, when swine, horned cattle, and horses were introduced, there were no traces among these islands of any native mammalia, except a species of bat. There are English and American mission stations on the islands, as well as several Roman Catholic establishments.

For our engravings we are indebted to L'Illustration, St. James's Budget, and Ueber Land und Meer. Our text is from The Troy Budget.

CRIME AND THE WEATHER.

THE literature of criminology is full of scientific attempts to analyze the complex mental states which give rise to excesses in conduct. They have received a microscopic scrutiny, and the influence of social condition, of race trait, of physical health, and many other factors which affect the prevalence of crimes of various classes have been somewhat carefully determined. The effect of weather conditions as a phase of the cosmical environment has, however, for the most part, been overlooked. From the standpoint of climate and its general influence upon mental characteristics, the subject has been attacked, but the definite meteorological conditions, the innumerable combinations of which give us the ever-changing thing which we call weather, have hardly been scientifically considered in their causal relation to conduct. This seems somewhat strange, for most of us are victims to the weather. Some are so susceptible to its influence that the east wind or a leaden sky is so oppressive that a silvery lining seems entirely wanting to the cloud of despondency which overspreads the emotional horizon. Such conditions play upon their high strung mental natures as the wind upon the strings of an Æolian harp, with the sole exception that the resulting tones are always discords. Some there may be who, like Johnson, scoff at such weaknesses, but the fact still remains that most of us are not immune to weather influences. Literature is full of allusions to them. Most of Dickens' tragic climaxes are set for the gloomiest weather conditions, and Shakespeare has hinged the entire plot of Romeo and Juliet upon a hot day. At the beginning of the third act he makes Benvolio, in an attempt to restrain his lively companion, say:

> "I pray thee, good Mercutio, let's retire;
> The day is hot, the Capulets abroad,
> And, if we meet, we shall not escape a brawl;
> For now these hot days is the mad blood stirring."

But his warning was disregarded. As a result, when the Montague and the Capulet met, they fought. Mercutio lost his life, Romeo was banished for slaying Tybalt, Juliet was forced to take the potion to avoid a hateful marriage with Paris during her lover's absence, and was discovered apparently dead by Romeo, who killed himself. Juliet, awakening, completed the tragedy, "falling dead on the body of her lover." Terrible results from the effects of a hot day.

The following study, together with several other of classes of data representing various excesses in conduct,* was undertaken in an attempt to demonstrate more exactly the influence of weather upon emotional states; not supposing that the weather is the immediate cause of such excesses, but secondarily effective, in producing mental states during which ordinarily inhibited impulses to act contrary to law and order would be given free play. The records of arrests for assault and battery for the city of New York for the years 1891–97 inclusive were made use of as a basis of the study. Their occurrence under definite meteorological conditions was compared with the occurrence of those conditions, and the results shown upon the accompanying charts.

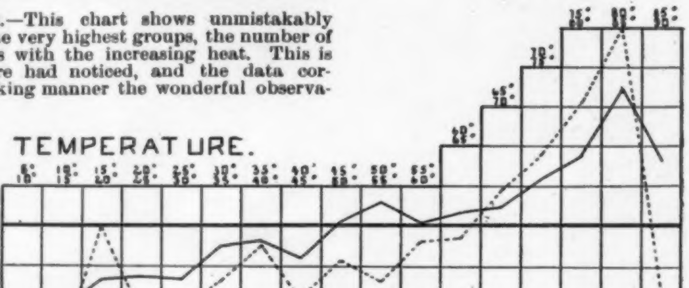
To explain the method of the problem. At the New York office of the United States Weather Bureau, the mean temperature, barometer, and humidity, the total movement of the wind, the character of the day, and the precipitation were tabulated for each of the 2,557 days of the seven years studied. From these records were then computed the exact percentage of the 2,557 days falling under each of the meteorological groups indicated at the top of the accompanying charts. For instance, 5.5 per cent. were found to have had a mean temperature between 25° and 30° F., 7.2 per cent. between 30° and 35°, and so on for each group of 5 degrees of temperature, each group of $\frac{10}{100}$ inch barometer, $\frac{5}{100}$ humidity, 50 miles movements of wind, fair, part cloudy or cloudy days, and days upon which there was $\frac{1}{100}$ inch or more precipitation. Now it can be seen that if these temperatures represent the prevalence of these different conditions, they also represent the probable or expected occurrence of assault for those conditions if the weather was in no way effective. That is, if 30 per cent. of all the 2,557 days were fair, we might, in accordance with the numerical law of probability, expect, in the long run, the same per cent. of all the assaults to have occurred upon fair days, if the character of the days were not a causal factor. The same would be true for any one of the meteorological groups indicated on the charts. Accidents might, of course, introduce error, and perhaps have, but with the large number of days and data considered, they would tend to be self-eliminating. This expectancy, thus computed, forms the basis of our comparison. The other term in the comparison is the percentage of all the cases of assault for the seven years occurring under each of the arbitrary meteorological groups. For the period the records at police headquarters showed that 36,627 males had been arrested for that crime and 3,134 females. Separate curves are shown for each sex for purposes of comparison. To give an example of the relation between occurrence and expectancy, 30·6 per cent. of all the days studied were recorded at the Weather Bureau as cloudy, but only 27·3 per cent. of the male assaults occurred on such days.

That means a deficiency of assaults for such conditions, and upon the charts the magnitude of deficiency (or excess) is expressed in the relation of occurrence to expectancy. 27·3 is 9 per cent. (of 30·6), less than 30·6, and that curve (character of the day) shows a deficiency of 9 per cent. for cloudy days. All the curves are to be interpreted in the same way. When a curve is below the horizontal base line, it indicates less than the expected number of assaults for the condition at the top of the column, and when above the base line, more. The lighter, horizontal lines represent differences of 20 per cent.

The entire curves are for males; the dotted, females.

DISTRIBUTION.—Although no curve is shown illustrating this fact, the monthly distribution of assault is closely related to the temperature. During the cold months it is deficient, reaching its maximum in July (28 per cent.)

TEMPERATURE.—This chart shows unmistakably that except for the very highest groups, the number of assaults increases with the increasing heat. This is what Shakespeare had noticed, and the data corroborate in a striking manner the wonderful observational powers of the great master. The minor fluctuations of the curves may be disregarded, as they are very probably due to accidents, but the general showing is one of marked deficiency for low temperature with a somewhat gradual increase to its maximum excess in the 80°–85° group, at which point a sudden drop takes place. This final decrease is in itself interesting. It seems without doubt to be due to the devitalizing effect of the intense heat of 85° and above. This has been determined by a study similar to this, for the death rate, which is found to increase wonderfully for such temperatures.



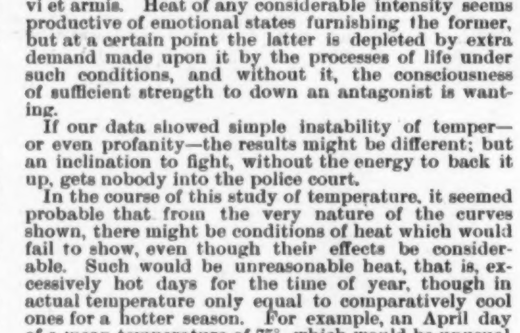
For fighting purposes, one must have not only the inclination, but also the energy to support his position vi et armis. Heat of any considerable intensity seems productive of emotional states furnishing the former, but at a certain point the latter is depleted by extra demand made upon it by the processes of life under such conditions, and without it, the consciousness of sufficient strength to down an antagonist is wanting.

If our data showed simple instability of temper—or even profanity—the results might be different; but an inclination to fight, without the energy to back it up, gets nobody into the police court.

In the course of this study of temperature, it seemed probable that from the very nature of the curves shown, there might be conditions of heat which would fail to show, even though their effects be considerable. Such would be unreasonable heat, that is, excessively hot days for the time of year, though in actual temperature only equal to comparatively cool ones for a hotter season. For example, an April day of a mean temperature of 75°, which would be unusual for that month, might, for all this curve shows, have a disastrous effect upon conduct, yet in the study of that condition for the year, the fact be entirely concealed by the soothing effect of an August day of same temperature. In order to discover such negation of results, temperature curves (not shown) were constructed for each month of the year. These showed that the unseasonably hot days of spring and fall are preeminently the pugnacious ones. The highest temperature groups reached in the months of April and October (65°–75°) showed an excess of nearly 50 per cent. of assaults, while the group 85°–90° for July and August showed less than 10 per cent. This is but a corroboration of the devitalizing effects of great heat shown by the temperature curve for the year.

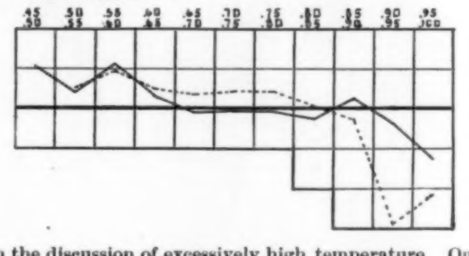
A comparison of the curves for males and females would seem to show that the latter are more affected by heat than the former. For almost all the groups, the deficiency or excess shown for males is intensified in that for females. This is especially shown in the excess for the 80°–85° group, and the drop at the end. Although for the highest temperature shown few men were left with energy enough to quarrel, it would seem that the fighting blood was entirely drawn from the veins of the fair sex.

BAROMETER.—Periods of low barometer are proved by our curves to be the harvest season for the bluecoats. These curves show even a greater regularity of trend than do those which we have just considered, though their tendency is in the other direction. They are, too, somewhat more difficult to interpret. It does not seem probable that the actual weight of the atmosphere itself is the direct cause of the results shown, but the barometrical conditions as accompaniments of other meteorological states; perhaps their relation to storms. The entire variation of the mercury column for New York is but little more than an inch, while one experiences a drop of five inches in going to Denver, Col., and five more in crossing the Rocky Mountains by almost any route, without experiencing any marked emotional change, so the density itself cannot be the cause. Low barometers are common to storms, but the excess in assaults did not occur at such times, as will be shown under our study of character of the day and precipitation.



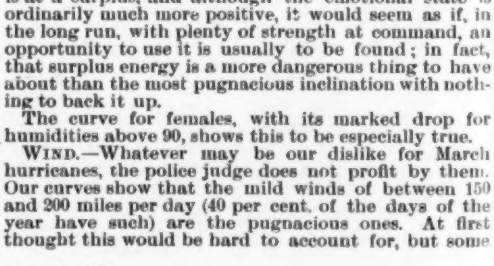
The same barometrical conditions frequently immediately precede storms—in fact, are a part of their meteorological preliminaries—and here we perhaps have a key to the problem. Many people "feel" a storm coming. Signals, both mental and physiological, more trustworthy even than the black flag of the Weather Bureau, tell them of its approach. If the emotional effects of such conditions be what seem to be indicated by our curves, we would do well at such a signal of storm not only to keep our shipping in port, but keep away from our enemies, especially if they are better fighters than ourselves. But little difference is shown here between the effects upon the two sexes.

HUMIDITY.—The effects of differing humidity as shown by our curves are, I believe, contrary to what is ordinarily thought to be the case. We find excesses of assaults for low readings and deficiencies for high ones. When we consider that muggy, sticky days, the kind that we all detest, are of the latter class, we are almost inclined to doubt the correctness of these results. Nevertheless, based upon 40,000 data, they must be taken as somewhat conclusive. The reason is undoubtedly this. Days of high humidity are not only emotionally but vitally depressing, and we have the same element entering into our problem that we had in the discussion of excessively high temperature. On such days, we perhaps feel like fighting, but such a thing is altogether too much exertion, and the police records are none the wiser. For low humidities, energy is at a surplus, and although the emotional state is ordinarily much more positive, it would seem as if, in the long run, with plenty of strength at command, an opportunity to use it is usually to be found; in fact, that surplus energy is a more dangerous thing to have about than the most pugnacious inclination with nothing to back it up.



The curve for females, with its marked drop for humidities above 90, shows this to be especially true.

WIND.—Whatever may be our dislike for March hurricanes, the police judge does not profit by them. Our curves show that the mild winds of between 150 and 200 miles per day (40 per cent. of the days of the year have such) are the pugnacious ones. At first thought this would be hard to account for, but some recent studies in England have made at least the deficiency for virtual calms explainable on the same basis as intense heat and high humidity.



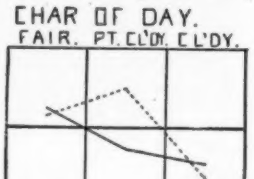
Dr. J. B. Cohen (see Smithsonian Report, 1895) has shown that the atmosphere in large towns at certain times contains more than five times as much carbon dioxide as that of the surrounding country at the same time. He does not give the meteorological conditions of the days upon which the excess was greatest, but it is, I believe, reasonable to presume that they were without wind. Certainly upon windy days, there would be sufficient ventilation to prevent any such discrepancy.

Now an excess of carbon dioxide in the atmosphere

* See "Conduct and the Weather," Monograph supplement to The Psychological Review

can only be produced at the expense of oxygen. But oxygen is necessary to and carbon dioxide baneful to all the vital processes productive of energy in the animal kingdom; hence, in great cities, during calms, this must be deficient. The increase in death rate (see "Conduct and the Weather") is conclusive proof of this. But since vitality is essential to such crimes as assault, they too must fall below expectancy. The deficiency for high winds, I shall not attempt to account for. The curve for females shows the same intensifying of effects that we have noted for the others.

CHARACTER OF THE DAY.—Days are characterized at the Weather Bureau as fair if for three-tenths or less of the hours from sunrise to sunset the sun is obscured, as partly cloudy if four, five, six, or seven-tenths are obscured, if more, as cloudy. It has no reference to precipitation. Strange as it may seem, the cloudy days are the freest from personal encounter which has attracted the police. This may be partly due to the fact that not so many people are upon the

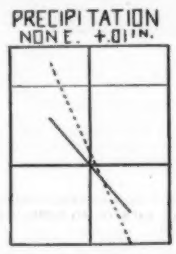


streets, but in other studies of similar nature, considering deportment in public schools and penitentiary and asylums for the insane, suicide, and the death rate, all except the last have shown the greatest deficiency for cloudy days. This seems explosive of many of our well founded beliefs. If it be true, fiction must choose fair days for its tragic climaxes, relegating its quieter movements to the cloudy.

Our thesis of reserve energy is applicable to an hypothesis for this curve.

The cloudy days are not the vitalizing ones, but the reverse.

PRECIPITATION.—This curve is exactly what we should expect from the last, showing, as it does, a deficiency of assaults for wet days, however much it may contradict our general opinions upon the subject. The



relation between the two sexes coincides with what has been shown upon the other charts.

The deficiency of crime for rainy days is certainly surprising, when we consider the excuse for being "out of sorts" which the disappointments attending stormy weather make legitimate, but we must conclude that ability is a more important factor than inclination, and that the problem of offensive crime is largely one of vital surplus. EDWIN GRANT DEXTER.

THE EXTERMINATION OF THE MOSQUITO.

To the Editor of SCIENTIFIC AMERICAN SUPPLEMENT:

In the SCIENTIFIC AMERICAN SUPPLEMENT for May 20, 1899, which has just reached me, I notice an interesting article by Henry C. Weeks, entitled "The Extermination of the Mosquito." It is a pity that so excellent and readable an article should have included the account of permanganate of potash as a mosquito remedy. In order that your readers may not be misled in this matter, I think it will be well for you to publish the following statement:

"One of the mosquito developments of the year has been the extensive publication in all sorts of newspapers of an item (usually credited to The Public Health Journal) which reads as follows:

"'Two and one-half hours are required for a mosquito to develop from its first stage, a speck resembling cholera bacteria, to its active and venomous maturity. The insect, in all its phases, may be instantly killed by contact with minute quantities of permanganate of potash. It is claimed that one part of the substance in 1,500 of solution, distributed in mosquito marshes, will render the development of larvæ impossible. That a handful of permanganate will oxidize a ten-acre swamp, kill its embryo insects, and keep it free from organic matter for thirty days, at a cost of 25 cents; that with care, a whole State may be kept free of insect pests at a small cost. An efficacious method is to scatter a few crystals widely apart. A single pinch of permanganate has killed all the germs in a 1,000-gallon tank.'

"The item is so obviously ridiculous upon its face that it would hardly seem worth while to make any attempt to refute its statements. Nevertheless, it has been so widely read that definite experimentation seems necessary to set the matter at rest. The unknown author's ignorance of the life history of mosquitoes in the opening sentence need not necessarily imply that he would not know a good remedy if he found one. Careful experiments were undertaken in July with various strengths of permanganate of potash in water containing mosquito larvæ from one to six days old. It was found that small amounts of the chemical had no effect whatever upon the larvæ, which were, however, killed by using amounts so large that, instead of using a 'handful to a ten-acre swamp,' at least a wagonload would have to be used to accomplish any result. Moreover, after the use of this large amount and after the larvæ were killed, the same water twenty-four hours later sustained freshly-hatched mosquito larvæ perfectly, so that even were a person to go to the prohibitive expense of killing mosquito larvæ in the swamp with permanganate of potash, the same task would have to be done over again two days later." [Bull. 17, new series, Division of Entomology, United States Department of Agriculture (December, 1898), pp. 55-56.] L. O. HOWARD, Entomologist.

U. S. Department of Agriculture, May 20, 1899.

ANCIENT GLASS MIRRORS.

THE art of making glass mirrors backed with brilliant metal is often regarded as a modern one, but, as shown by M. G. Angerville in an article in La Science Illustrée translated by The Literary Digest, recent discoveries have shown that it was in use by the ancient Romans, although lead was the metal then commonly employed. Says M. Angerville:

"The ancients generally employed metallic mirrors. They were also acquainted with glass mirrors, but these latter were always of small size. The existence of glass mirrors among the ancients was known to us, before last year, only by several passages in the works of different authors.

"Pliny mentions the glass mirrors found at Sidon, but does not speak of their metallic covering. Alexander of Aphrodisias, a commentator of Aristotle, says in his 'Problems,' which date from the third century of our era: 'Why have glass mirrors such brilliancy? Because they are backed with tin.'

"In the remains of the old Roman camp of Saalburg has been brought to light a piece of a mirror backed with gold-leaf, and other similar mirrors have been found at Ratisbon.

"'The use of metal leaf—gold, silver, copper, iron, tin—was current in the arts among the ancients and in the middle ages,' says M. Berthelot, who has recently investigated the history of the mirror industry. 'The fabrication of gold and silver leaf has often been described. Among other uses, these leaves were applied to glass by glue. Artists must have soon perceived that reflected images were produced by objects thus backed, but it is difficult to obtain perfectly reflecting surfaces in this way.'

"For this reason the use of melted lead was devised. This last point was established by M. Berthelot in 1897.

"M. Robert, custodian of the Archeological Museum at Reims, sent to the illustrious chemist the debris of mirrors found in the Gallo-Roman tombs of the third and fourth centuries of our era, discovered in the environs of the city. The largest was 5 centimeters [2 inches] in diameter; it was curved like a watch-glass, and about half a millimeter [0·02 of an inch] thick. Its convex surface, smooth and shining, represented a spherical segment corresponding to a sphere of about 20 decimeters [80 inches] in diameter. The concave surface was filled with lead, changed largely into carbonate and litharge, owing to the long action of the air and the moist earth. The other fragments gave similar results when examined and chemically analyzed.

"M. Berthelot thus explains their mode of manufacture: 'The metal was applied by pouring a thin layer of melted lead into the concavity of the glass, which was probably heated previously. . . This application may have been made to the separated segment or to the interior of the original hollow sphere, which perhaps would have been the best way. It could then have been cut up into mirrors after cooling. In any case, the application of such thin layers of lead must have been accompanied by considerable oxidation. . . .'

"These mirrors of glass backed with metal were carried throughout the Roman empire, to Gaul and Thrace, and even to Egypt. In fact, in August, 1898, M. Berthelot had occasion to examine one of the thirteen glass mirrors found three years before in Bulgaria, among the ruins of a temple of the second and third centuries of our era, and two other mirrors found in the ruins of the Egyptian city of Antinoë.

"The first, sent by M. Dobrusky, director of the Sofia Museum, is circular, 47 millimeters [1⅞ inches] in diameter; it has traces of a handle and is inclosed in a metallic frame decorated with a garland. The backing layer, formed originally of melted lead, is one-tenth of a millimeter thick.

"The two others were sent by M. Guimet, founder of the Museum. One of them was surrounded by a pentagonal plaster case; it was only 5 millimeters [⅕ inch] in diameter. The second, found in a Byzantine tomb in the hands of a young girl, still gives very clear images; it is framed in metal ornamented with fourteen little roses in relief, and is furnished with a ring.

"All are made in the same way: they are small, very thin, and evidently cut from blown-glass globes into which melted lead had been poured. They were then placed in a frame of metal, plaster, or wood.

"What became of this process early in the middle ages? Was it lost for the time, or did its tradition continue? New discoveries will doubtless enlighten us on this point.

"However this may be, in 1250 Vincent de Beauvais describes the fabrication of glass mirrors, and shows how to pour the melted lead into the hot glass. The monk John Packlam, Roger Bacon, and Raymond Tully also speak of it.

"It was not until toward the end of the fifteenth century, at Murano, that melted lead was abandoned. It necessitated the use of heat, and consequently of thin glass, to avoid breaking. The properties of tin amalgam, then recently discovered, enabled a new method to be used.

"At the beginning of the sixteenth century there were in use together metallic mirrors, glass mirrors backed with metal, and tinned mirrors."

BRITISH AGRICULTURE IN 1898.

CONSUL Marshal Halstead sends from Birmingham, under date of January 3, 1899, a newspaper review of agricultural conditions in Great Britain during the past year. The wheat and barley yields, it appears, are the largest recorded, and the oats harvest has been exceeded only twice. The acreage in wheat was 2,102,206, an increase of 213,045 over 1897; there were 1,903,666 acres in barley, a decrease of 132,024 acres as compared with the preceding year; the acreage of oats also showed a decrease, being 2,917,760 in 1898. The yield in bushels was: Wheat, 73,028,856; barley, 68,051,918; oats, 118,920,917. Experiments made in sugar beet growing have resulted in an average yield of 19 tons 17 cwt. per acre, proving that good commercial sugar beets can be grown well in England, as the average for Germany in the same year was 11·13 tons, and for France 11·11. The beets are larger than those grown in America and are exceptionally rich in sugar. An important incident of the year was the advocacy, in a speech by the Minister of Education, of the establishment of a national system of agricultural education, to be grafted on the elementary schools in all rural districts.

THE CORK TREE, QUERCUS SUBER—ITS HISTORY, CULTIVATION, AND USES.

By NICOLAS PIKE.

CORK is the exterior bark of a tree belonging to the genus of the oak family which grows wild in the southern parts of Europe, especially France, Spain, Portugal, and Tuscany.

It was known to the Greeks and Romans, and was called by the former "phallus." Theophrastus reckons it among the oaks, and says it has a thick, fleshy bark which must be stripped off every three years to prevent it from perishing. The only difficulty in reconciling the description given by this author with our modern acquaintance with the cork tree is, that the Greek writer says that it loses its leaves annually, whereas our tree is an evergreen. Clusius mentioned the cork tree as deciduous. In the Pyrenees, near Bayonne, Spain, and Portugal, Italy and the southern parts of France, it retains its foliage. The suber of the Romans was the cork tree of the present day. Pliny writes about the cork tree, and we find that it was applied to as many purposes then as it is at the present day. The fishermen used it as floats for their nets, to keep them at the surface of the water, the same as they do at the present day. The Romans used it on their shoes; cork soles secured the feet from moisture. The making of jackets to assist persons in swimming is very ancient. The Roman whom Camillus sent to the Capitol when it was besieged by the Gauls put on a light dress and placed cork under it, because, to avoid being taken by the enemy, it was necessary for him to swim through the Tiber. When he arrived at the river, he bound his clothes upon his head, and placing the cork under him, succeeded in his attempt. The most extensive use of cork at this day is for stoppers to bottles. Stoppers of cork were first introduced after the invention of glass bottles, and of which no mention is made before the fifteenth century. The Syracusan wine flasks resembled somewhat our bottles; and in later times, glass flasks have been in use incased in wicker work. German apothecaries used cork stoppers about the end of the last century. Before that time they used stoppers of wax, which were expensive and troublesome.

The cork tree is not a handsome tree, but resembles and retains the type of the genus Quercus, and an ordinary person would at once recognize it as a oak. The bark is often two or three inches in thickness, and of a delicate light hue. Oftentimes a forest of these trees affords a rich and picturesque appearance, as the upper parts of the trunks are frequently covered with a thick layer of moss, from which springs a large number of beautiful ferns, the long plumes of which are often found deeply rooted in its spongy depths. The cork tree is successfully grown in California, and was introduced there as early as 1853. Mr. I. H. Lick, of Lick's Mill, of St. Clara County, planted acorns of the cork, Quercus suber, which grew finely, and in seven years he had a forest of eighty-five trees from 15 to 20 feet in height, and from 8 to 10 inches in diameter. This indicates that the climate is very favorable to the growth of this tree, which is valuable. It will grow in almost any soil, and would thrive well in Southern California, and in time pay the farmer well to plant forests on his waste lands.

Its Cultivation and Uses.—The Portuguese have an excellent way of cultivating this tree. It is very peculiar, although I have seen it done many times, successfully. A large branch is selected from a full-grown healthy tree, oftentimes from 15 to 25 feet in length. A strip of bark is removed about 6 inches wide all round it, where it is intended to cut it off later. After the removal of this bark a composition of cow manure and rich vegetable soil is spread over a double thickness of coarse cloth, and then the whole is bound over the place left bare by the removal of the bark. This is tied tightly on. A small tin can filled with water is hung over this, and is made to drip slowly, so as to keep the bandage of loam moist. In a short time the branch takes root, and is sawed off and planted in rich soil prepared for it. We have seen a tree cultivated in the manner described, quite as large and healthy as one grown from seed seven or eight years old.

When the cork tree is about fifteen years old, it is fit to be barked, and this can be done successfully for eight years. The bark grows up again, and its quality improves as the age of the tree increases. If care be not taken to strip the bark, it splits, and peels off by itself, being pushed up by a second growth forming under that of the preceding year. There are different methods of stripping. The Portuguese cut it in sheets or tables, slitting it from the tree with a two-handled knife, after having made a circular cut at the parts where the branches spring. Another method is as follows: A circular cut having been made at the top, and likewise at the bottom of the tree, several incisions are made perpendicularly along the trunk; by these operations the bark being cut off from communication with either the lower or higher parts of the tree, it is done entirely by hand; thus merely extending the process of nature, which, if the bark were not removed, would rift it, and detach it from the tree. After having stripped the bark the Portuguese burn it; that is, they lay the convex side of it to the fire in order to clear the surface, and reduce it to straightness. Previously to this operation the pores of the bark are open, and its consequent sponginess of texture would make it not only give too much way to the knife, but would render it ineffectual as a means of preserving liquids. It shrinks with the moderate application of heat, and thereby closes the pores, by which any filtration might be effected. When the judgment of the burner has been sufficiently exercised in flattening the bark, and by artful introduction of soil and dirt in repairing its defects, it is laid up in stacks for sale, and bought in that state by the merchants for exportation. Another

method used in straightening the bark is to pile it up in pits loaded with heavy stones, by which method it becomes flat; this is afterward more completely effected in a damp cellar, and is called "laying the cork." When this operation is finished it is dried over a strong fire in what is called a "burning yard;" from negligence in this process it receives too much of that black color which is so frequently discovered in articles made of cork. When sufficiently dried, it is ready for stacking. If burning ever be used as a cover for defects, it is not an original design, but an accidental advantage which is taken of a necessary process. Bungs and taps are always charred on both surfaces; good bottle corks, though the cork of which they are made is likewise subjected to the operation of fire, do not, after they are cut, exhibit any marks of the element; being cut in the lengthway of the wood, the pores lie in a contrary direction, and the charring consequently is taken off by the process of rounding them.

THE TURGAN STEAM GENERATOR.

TUBULAR steam boilers are at present the object of frequent researches, and the systems that have been devised are very diverse, since the difficulties to be solved are very numerous.

To give the water the best circulation, to utilize the gas of combustion to the best degree possible, to allow the expansion of the parts to take place freely in order to prevent leakages, to render the taking apart of the apparatus easy and rapid, and, at the same time, to produce a boiler having a slight weight and occupying little space, are so many points that are particularly attracting the attention of manufacturers. We think it will be of interest to describe, from among the most recent of these apparatus, a boiler which figured at the Exposition of Automobiles, and was devised by M. Turgan.

The generator, which is horizontal, consists of a longitudinal cylindrical reservoir forming, as it were, the upper edge of a triangular prism, of which the faces are formed of tubes that debouch in the reservoir, and at the base rest against the grate of the furnace. As shown in the accompanying figure, the vaporizing elements, which are held at only one of their extremities in order to permit of expansion taking place freely, are formed of two bundles of tubes. The external tubes open at their upper extremities in the longitudinal reservoir, while at the base they are closed by screw plugs that are external to the grate and are protected by screens. The internal tubes, which are open at both extremities, end in a collector within the upper reservoir, with which they have the same axis.

It is easy to see that, if the feeding be done exclusively in the internal collector, the water will descend through the small tubes, and then ascend mixed with the steam that forms through the annular space existing between the tubes.

The internal collector thus serves as a guide and forces the water always to descend regularly and in so much larger quantity in proportion as the vaporization is more active.

The steam produced, making a turn around the screen, is dried by means of arrangements that are familiar, and collects in a dome.

As it has been generally necessary to guide the flames and hot gases, M. Turgan has, to this effect, formed screens with tubes of wide diameter that taper at their extremities and touch each other according to one generatrix.

These screens are interrupted here and there, so that the gases return to the front from the back in traversing the bundle of tubes, as shown by the various arrows that are observed in the principal figure and in the section and plan to the right. Screens are arranged also for protecting the shell of the generator.

After having thus briefly pointed out the very simple principle of the apparatus, we desire to call attention to various interesting 'arrangements. Attention had to be paid to the liability of the tubes to become incrusted with scale, and to become foul, despite their inclination. Although the tubes are very easy to clean, since they are rectilinear and are closed by screw plugs, the boiler is provided with a decanter. The feed water, instead of directly entering the internal collector, enters a sort of gutter, whence it afterward escapes into the collector. A system of piping permits of extracting at will and under pressure the mud and other impurities of the water.

Owing to the progress made in the metallurgy of cast steel, the reservoir of the small sized boilers is made of this material in two pieces. It is thus easily taken apart and inspected internally.

Finally, even in the smallest apparatus, the tubes are rendered individually dismountable, through very simple arrangements either from the exterior or interior of the collector.

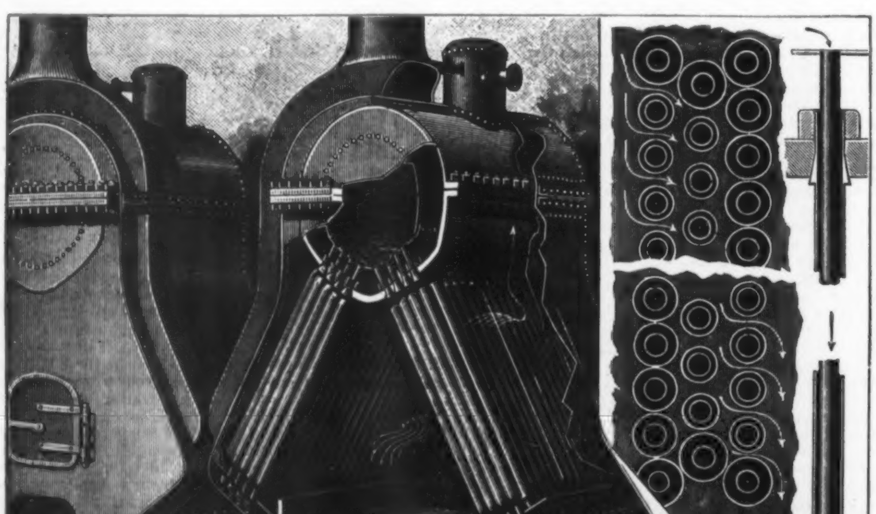
The figure represents a method of dismounting from the interior, assured by a nut which, upon the tube plate, tightens the tube that is provided with a conical inflation.

In this latter boiler (as we have shown by the very principle of the apparatus) the circulation of the water, which is very rapid, is perfectly guided, and the level thereof absolutely stationary, since the plane of the internal liquid is protected against any disturbance.

The weight of the whole and the total amount of space occupied are particularly reduced, and so it is easy to apply the Turgan boiler to automobile vehicles, to stations of electricity, and to ships. Finally, there has been quite recently devised a special type with a view to heating with wood and to a division of the apparatus into parts for shipment to colonies.

The following figures will allow the satisfactory operation of this apparatus to be appreciated. A boiler weighing 1,980 pounds, with a heating surface of 135 square feet, gives 1,760 pounds of steam per hour with a rendering of 8 pounds of steam per pound of coke, for a combustion of 40 pounds of coke per square foot of grate surface

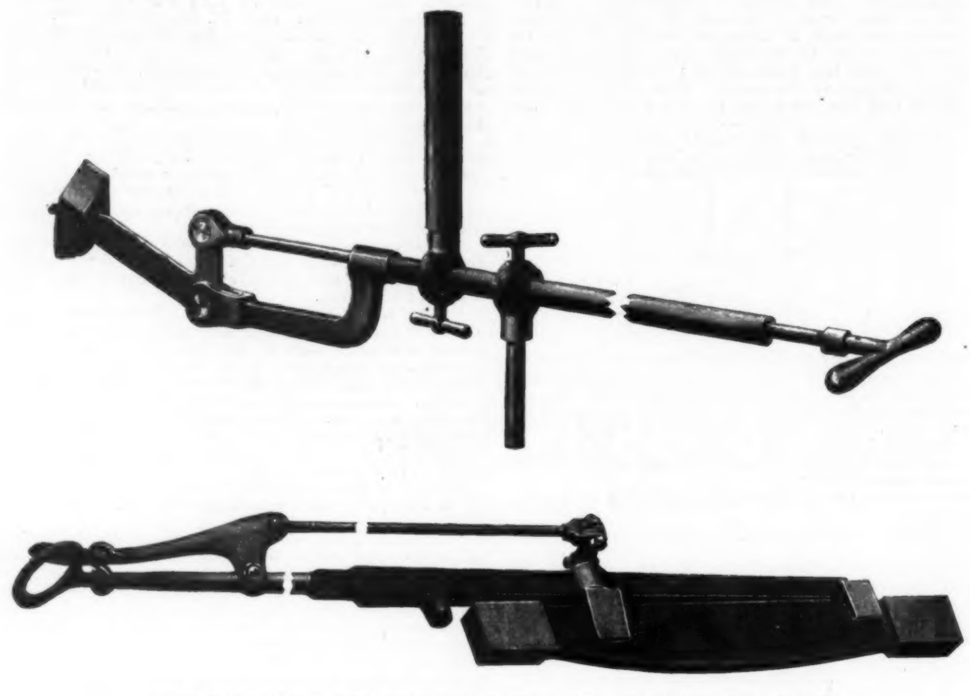
For the above particulars and the engraving we are indebted to La Nature.



THE TURGAN STEAM GENERATOR.

BROWN'S BOILER SCALING HAMMER AND FIREBAR INSERTER.

THE annexed illustrations show two new boiler tools now being introduced by Messrs. Walker Brothers & Company, of 44 Constitution Street, Leith. The upper view represents a scaling hammer to get at the less accessible parts of a boiler. It will be seen that the hammer is carried at the end of a tubular frame, and is worked by a rod and cross handle. Both the frame and the rod are capable of being extended to reach different positions in a boiler. There are two pins which form heels on which the tool may rest when at work, and these can be shifted and extended as required. Various shapes of hammer heads can be used at will.



BROWN'S BOILER SCALING HAMMER AND FIREBAR INSERTER.

The lower view shows a "furnace bar inserter," with a bar in position ready to be pushed into its place. It will be seen that the inserter comprises a fork and a gripper, the former acting as a guide for the bar, and the latter as a jaw to hold it securely. The jaw is mounted on a shank which passes through the holder, and has an arm at the upper end by which the jaw can be rotated to get a good grip on the bar. The jaw is, of course, worked from the handle end of the tool, and when it has been fixed the whole arrangement is locked by a hook, as shown.—Engineering.

TURF BRIQUETTES IN GERMANY.

ABOUT two years ago, experiments were commenced in manufacturing briquettes from peat or turf. It is now very evident that this new adventure will meet with success. The process of manufacturing is as follows:

After the turf has been cut from the moor, it is brought, in a wet condition, to a breaking machine, which reduces it to small pieces, whence it passes to a second machine, where it is cut and ground quite fine. The turf is then dried by passing through a large cylinder, filled with exhaust steam from the engine. The inside of the cylinder is filled with large tubes, after the style of a boiler, resting at an angle and continually revolving. This permits the mull to pass through perfectly dry. From here it is carried to the hopper which feeds the press. The press, which forms the briquettes, is operated by a 75 horse power engine and finishes one briquette with each stroke.

The machinery in use at present can be improved in many respects, and can be made to press more than one briquette at a time. The capacity at present is about 80 briquettes a minute, or 35 tons a day, while the presses used in manufacturing briquettes from bituminous coal and anthracite (from slack and screenings) have a capacity greatly exceeding that of the turf press. Coal briquettes retail at 90 pfennigs (21 cents) per centner (112 pounds) and average 98 briquettes to a centner—about 4½ briquettes for 1 cent—while the turf or peat briquettes retail at the rate of 130 briquettes for 15 cents, or more than 8 briquettes for 1 cent, making a very cheap fuel.

In addition to cheapness, it has other merits. It is clean in handling, packs very nicely in bins, gives a good heat, and in a closed stove with only a slight draft will remain in a glowing state for ten hours. In an open fireplace or grate it naturally burns much quicker. Only a few men are required to operate the machinery. Women or small boys are employed in stacking the briquettes. The cost of material and working 1 ton of briquettes at Langenberg, where one plant is located, is estimated at about $1.55. With improved machinery and better facilities, the cost could be reduced. The figures of cost of production, etc., are based on the German scale of wages—75 cents a day for a man and 25 cents per day for a woman. The machinery is patented in Germany and England.

JOHN E. KEHL, Consul.

Stettin, October 25, 1898.

There are 1,200 miles of railway in operation in Poland.

GERMAIN'S LOUD SPEAKING TELEPHONE.

CONCERNING M. Germain's loud speaking telephone, which has been operated experimentally at the office of the Minister of Telegraphs, there has recently been much discussion, although up to the present no accurate description of the apparatus has been given. Having had the good fortune to meet the inventor in his laboratory, at Fontenay-aux-Roses, and having been kindly allowed by him to examine and listen to the new instrument, we are in a position to describe it.

Fig. 1 shows the principal arrangements adopted. In No. 1 we have a general view of the transmitter, and, in No. 2, a transverse section. In front there is an aperture in which end four small tubes, which are placed before vibrating disks, *A* and *B*. These disks, which are formed of silicate of potash and magnesia, possess a peculiar nature such as to be very readily influenced by all vibrations. Upon them is fixed a series of small cylinders that contain carbon in powder. When the hearing is to be done by an audience, the powdered carbon is replaced by granules of a metalloid, which are more refractory.

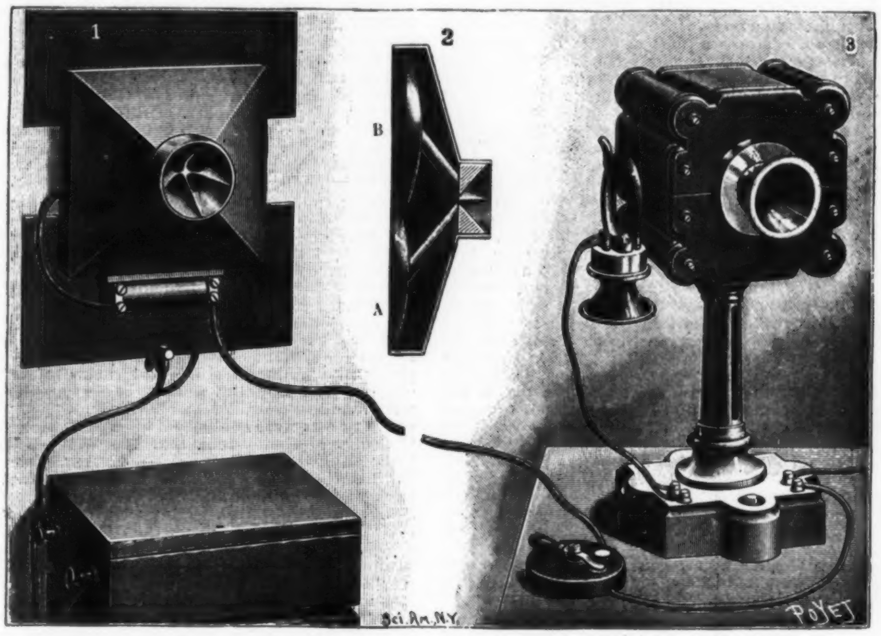


FIG. 1.—PRINCIPAL ARRANGEMENTS OF THE GERMAIN TRANSMITTER AND RECEIVER.

1. Transmitter. 2. Section of the transmitter. 3. Receiver.

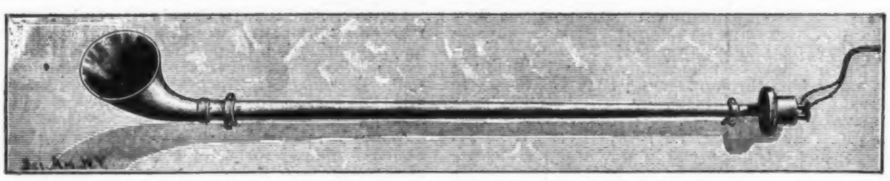


FIG. 2.—RECEIVER FOR HEARING IN A GARDEN.

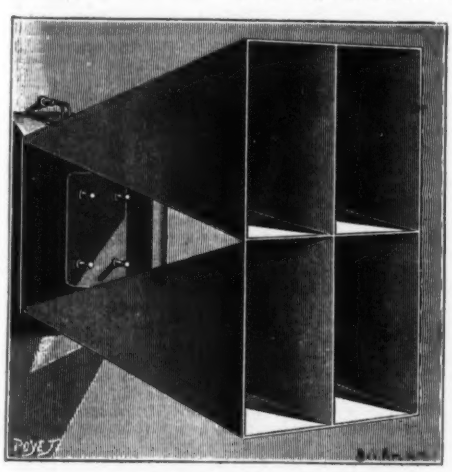


FIG. 3—ANOTHER MODEL OF THE TRANSMITTER.

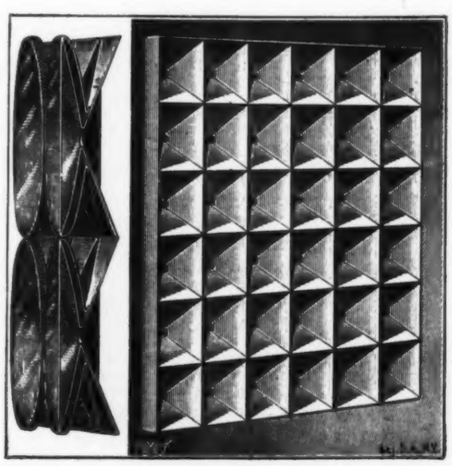


FIG. 4.—TRANSMITTER FORMED OF A SERIES OF JUXTAPOSED TRANSMITTING CONES.

Such an arrangement of the microphone, with a certain current intensity, gives very remarkable results. On the exterior of the microphone there is an ordinary induction coil of the model adopted by the state, and having, as resistances of the primary and secondary circuits, 1·5 ohm and 150 ohms respectively. This coil is seen in the figure fixed conspicuously beneath the mouthpiece.

For the trials which we witnessed, in a special apartment, the transmitter was connected with the extremity of an experimental line simulating the one that extends from Paris to London. At the other extremity was placed the receiver (Fig. 1, No. 3). For actuating each of the transmitters on this line, four elements of the Germain battery were employed; and with these the call in continuous currents was made at the same time. Through an arrangement of a multiple commutator and five small secondary tubes, it is possible to do the calling without the use of a battery properly so called.

At the other extremity of the line, in the inventor's laboratory, there was a Germain receiver mounted upon a foot and provided with a bell-shaped mouth, having an opening of four inches in diameter. Upon speaking in front of the transmitter, there was heard at every point of the laboratory a loud, clear, well modulated voice, unaccompanied with any nasilization.

It must be remarked, however, that song and instrumental music are much more intense, and likewise very clear. It is possible to speak softly without a loud voice ceasing to be heard in the room in which the receiver is placed.

In the laboratory there was likewise placed a second receiver formed of a slightly conical tube 0·4 inch in diameter at one extremity and 2·75 inches in diameter at a maximum, and 6·5 feet in length (Fig. 2). This tube was fixed against the wall and permitted of hearing in the garden that surrounded the house. During the day, the external noises diminish the range in the open air; but at night, it is possible to hear vocal and instrumental music or the powerful voice of an orator at a distance of 100 yards from the receiver. Conversation in an ordinary tone can be carried on at a distance of fifty feet only.

In the experiments that we have just mentioned, there was employed only the first model of the microphone, which operates with 4 battery elements; but there are other models that are capable of operating with 6, 10 and 15, and even a larger number of elements, according to the intensity that is desired. It is possible, in fact, for the Germain microphone to support currents of from 10 to 25 volts and of from 0·5 to 25 amperes without any perceptible sputtering or frying sounds. For ordinary conversation, the first model suffices perfectly. It is supplied by four elements which give an intensity of half an ampere. This is the economic condition that is adapted for a satisfactory exploitation. When it becomes a question of making applications, such, for example, as to the theatrophone, it will be necessary to adopt other arrangements and to choose higher current intensities. Figs. 3 and 4 illustrate transmitters that may be used in such applications.

Finally, we shall mention the very interesting experiments in phonographic inscriptions which M. Germain has now under study. The voice of a person speaking at a couple of yards from the aperture of the microphone is printed through a line of more than 60 miles in length upon the roller of a phonograph. This method permits of easily registering speech in the absence of a correspondent or of performing electric stenography. Fig. 5 shows the principal arrangements adopted. To the right (No. 3) is situated the transmitter of which we have spoken above, along with the battery, the microphone and the induction coil. The current is transmitted through a line of a length that may vary and reach a length of 240 miles, and may be partially aerial and partially subterranean. The line is connected with the receiver that may be seen mounted upon the phonograph in No. 1 (Fig. 5). As shown by the details in No. 2, the receiver is provided with a tube which connects its orifice with the vibrating disk of the phonograph. These experiments in registering, which we have had an opportunity of witnessing, are very interesting and succeed very well. The conversation, while it is registering, is heard in a loud voice.—L. Leroy, in La Nature.

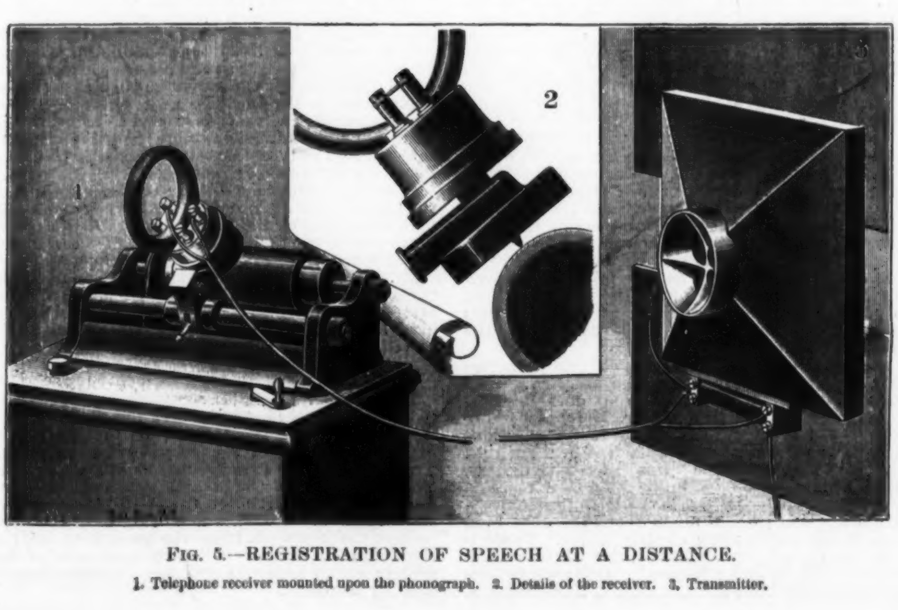


FIG. 5.—REGISTRATION OF SPEECH AT A DISTANCE.

1. Telephone receiver mounted upon the phonograph. 2. Details of the receiver. 3. Transmitter.

ELECTRIC RAILWAYS IN GERMANY.

I GLEAN from the last number of the Electrotechnische Zeitung the following statistics:

Up to the end of the year 1891, the number of cities in the German empire enjoying the advantages of electric street railways was three; up to the end of 1892, five; 1893, eleven; 1894, nineteen; 1895, thirty-two; 1896, forty-four; 1897, sixty-one; and on the 1st of September, 1898, no less than sixty-eight. In thirty-five other cities or districts, railways are in the course of construction or finally determined upon. The entire length of electric lines in operation in Germany on September 1, 1898, was 888 miles, and the total trackage was 1,205 miles. The number of motor cars was 3,190, and the number of trailers 2,128. The length of the new lines in course of construction or about to be begun at that date was 677 miles, and their total trackage 830 miles.

Most of the large industrial cities in Westphalia and the Rhine Province are connected by a network of electric roads, which serve not only for passengers, but for freight traffic.

The electric street railway of Hanover was built under the supervision and direction of an American from Philadelphia, and was opened for business on May 1, 1892. It was one of the first electric lines inaugurated in Germany, and is now one of the best systems in existence. The cars are modeled after our American ones, and the tracks are of heavy steel, laid on a substantial foundation of concrete. The fare for a course of, say, 2 miles within the city limits is 10 pfennigs, or

less than $2\frac{1}{2}$ cents of our money. Universal transfers are granted. The speed is about 8 miles per hour, and the cars run smoothly and with but little noise. Within the mile circuit, and upon some of the principal streets extending to the city limits, the cars are run on the accumulator system; but when the outskirts are reached, the accumulators are released from service and the cars are run by overhead trolley. The lines extend, on almost every road, miles into the surrounding country. The trackage of the Hanover Electric Railway now amounts to over 105 miles. The equipment consists of over 41 overhead trolley cars, 161 accumulator and trolley cars combined, 167 trailers, 20 locomotive, 4 sprinklers, and 24 freight cars. There are six power stations, four of which furnish, in addition to power for the cars, electric light for streets and roads. The motor cars are from 17 to 34 horse power, and the locomotives 50 horse power.

W. K. ANDERSON, Consul.

Hanover, January 13, 1899.

ÆTHERIC TELEGRAPHY.*

By W. H. PREECE, C.B., F.R.S.

ON the 21st of February, 1894, I read a paper in this room on "Electric Signaling Without Wires," in which I attempted to show how at that time "we were gradually by patient plodding creeping along toward the period when I hope we shall be able to make real practical use of electro-magnetic disturbances." To-night I propose to show you that we have attained that object. The experimental stage in wireless telegraphy had been passed in 1894 and we were then entering the commercial stage. I said in that paper: "The conditions are now so clear that given the localities between which it is desirable to communicate, it is a mere matter of calculation to show what has to be done. It would be quite easy to speak between France and England across the Straits of Dover."

In March, 1895, the cable connecting the island of Mull with the mainland was broken, and as some time might elapse before the repairing ship could reach the locality, communication was set up with that island by my system of ætheric telegraphy. A gutta-percha covered copper wire $1\frac{1}{2}$ miles long was specially laid along the Argyllshire coast, and the ordinary iron wire connecting Craignure and Aros in Mull was used. The mean distance separating the two wires was about three miles. There was no difficulty in communicating.

Public and press messages were regularly transmitted until the cable was repaired. It created as much sensation at the time as Mr. Marconi's recent experiments from Dover to Boulogne have excited during the past week or two. Signaling through space without wires became a practical operation.

In 1896 a cable was laid for the War Department from Lavernock near Cardiff to the island of Flatholm in the Bristol Channel. There are two important forts protecting the channel at these two points. The cable crossed a very much frequented route and an anchorage ground. It was speedily broken. The communication being very necessary, the cable was replaced early in 1898 by an ætheric telegraph, and since that time to the present day this communication has been maintained uninterruptedly, and is in daily use by the soldiers who work it.

I will show you the principle on which it is worked. It is due to the formation of electro-magnetic waves of induction. These waves, as they rise and fall, set up electro-magnetic disturbances in conductors in their neighborhood, and if these conductors form part of a telephone circuit, musical sounds are produced in the telephone if the disturbances are rhythmical. Vibrations of about 400 per second give the most pleasing and effective note, and when the note is broken up into dots and dashes, messages can be sent by the Morse alphabet.

You will preceive how simply the thing works, but you will also learn how rapidly the effects observed diminish as the distance increases when we use coils. The law regulating this distance is very simple. Indeed, in practice, and when the distance between the coils is considerable compared with the diameter of the coils, the effect diminishes as the cube of the distance. The distance to which communication is possible by overhead wires across a channel is limited by the length of the wire on each side, and by the delicacy of the receiving apparatus.

Attention is called at Lavernock and Flatholm by a very ingenious invention of Mr. Sydney Evershed. The vibratory currents are not used to produce sound, but they set up at the distant station vibratory movements in two loops of fine wire oscillating in a strong magnetic field at the low frequency of 16 per second in opposite phases. When these loops are properly timed, and the vibrations have sufficient amplitude, they make contact, complete a local circuit, and ring a trembler-bell.

Prof. Oliver Lodge has devised another mode of calling attention. He proposes to produce loud sounds by making the coil of the telephone vibratory, instead of using an iron diaphragm, and transmitting these vibrations directly to a sound-board. The magnetic field in which the coil vibrates is produced by a powerful horse-shoe magnet. The Post Office is going to give this new call a practical trial. It is hoped that it will develop into a new receiver.

I am by no means satisfied that we have reached finality in this form of ætheric telegraphy. There is vast room for improvement. We can increase the energy emitted at the sending end, we can enlarge the primary circuit by using heavier copper and increasing the size of the coil. We can vary the frequency of the currents and also the character of the receiving apparatus. Indeed, there is a potentiality of research and invention in this field for those who have leisure and inclination. If it had any serious commercial value before it, it would doubtless be exploited by enterprising manufacturers. Perhaps unfortunately, I did not patent it, and I have therefore no financial interest in it. The Post Office up to the present have used it practically only twice. It failed to act through sea-water, owing to the rapid absorption of the energy by the sea, and therefore it failed to be useful for light-ships, but in the meantime a new method of doing the same thing in another way has been devised by Mr. Marconi, which has created a great sensation and to which I must now refer.

Instead of using electro-magnetic waves of low frequency—400 per second—as I do, he uses Hertzian waves of very high frequency, probably of as many millions per second. He employs an ordinary induction coil such as is used to illuminate vacuum tubes or to excite Roentgen rays. The primary circuit contains an accumulator of 8 cells and a Morse key which can direct through it currents of long and short duration so as to form the Morse alphabet, as in ordinary telegraphy, to send messages. The secondary circuit ends in a radiator composed of two metallic spheres, between which sparks pass. One sphere is connected to the earth and the other to a vertical wire, whose length varies with the square root of the distance through which it is desirable to communicate. This wire is suspended by a pole or mast. Each spark is composed of extremely rapid oscillations of electricity, setting up those electric waves which are known as Hertzian, though they ought to be called Maxwellian, for it was Maxwell who indicated their existence, while Hertz experimentally detected their presence and showed us how to measure them. By this apparatus every depression of the key causes rays of electric waves to be emitted through the æther in every direction from the radiator as long as the key is held down. Thus those electric waves are transmitted through space exactly in the same way as light waves, and they follow precisely the same laws. Messages flashed by the heliograph from the Himalayas to the plains are signaled in the same way and by the same medium as Marconi's messages across the Straits of Dover. The first recorded message from Agamemnon to Clytemnestra, announcing the fall of Troy, was sent by the same agency. There is nothing wonderful in this. The wonder is that these electric waves should be detected at great distances through all weathers and seasons, during the day and night, and in spite of fog, and snow, and rain.

They are detected by a very simple apparatus. It is called a coherer, and it forms a telegraphic relay. A small glass tube, about $1\frac{1}{2}$ inches long, has inserted in it two silver pole-pieces which tightly fit the tube, but which are separated from each other by a space of about the fiftieth of one inch. This space is filled by a mixture of fine nickel and silver filings with just a trace of mercury. The pole-pieces have wires attached to them which enable the tube to form part of the circuit and which are sealed in the tube when the latter is exhausted. In its normal condition this metallic powder is virtually an insulator. The particles very slightly touch each other—so slightly that no current passes. They lie higgledy-piggledy, anyhow, in disorder. But let them be placed in an electric field, let electric waves pass through them; they are instantly "polarized;" they are installed in martial array; their mutual contact is increased; they are subjected to pressure; they "cohere," as Prof. Oliver Lodge expresses it; they become a conductor, and an electric current passes if the coherer forms part of the circuit of a local battery. They will continue to act as a conductor until they are "decohered" or restored to their normal insulating condition by mechanical shaking. Mr. Marconi causes a small hammer to strike the glass by the very current the coherer has caused to pass. If the waves have ceased, the tube is instantly decohered. If the waves continue, there is no apparent decoherence. This current can at the same time emit either a sound or record signals on paper by ink which in each case can be read. One side of the coherer is connected to a vertical collecting conductor similar to the transmitting conductor, and the other side is connected to the earth. The coherer is an extremely reliable instrument—stable and certain in its action. I have one given to me by Mr. Marconi in 1897 that has never failed to act. I am using it to-night.

It will be seen that the apparatus is characterized by extreme simplicity. The vertical conductor is common to the transmitter and the receiver. At each terminal there must be both transmitting and receiving apparatus, but the effect is improved if the receiving wire be thin and the transmitting wire thick. When signaling from A to B the vertical conductor at A becomes a wing of the radiator, while that at B is a wing of the coherer. The reverse takes place when signaling from B to A. The coherer is protected from the influence of its own radiator by being incased in an iron shield.

The rays can be directed in any given direction by parabolic reflection, but this is effective for only short distances, for a long vertical conductor cannot be used with reflectors. For long distances, tuning or syntonizing is the most probable effective mode of securing secrecy; but Mr. Marconi is still in the experimental stage in this branch of the subject. Syntony is attained when the transmitted impulses of a vibration recur in the same period as the natural period of vibration of the receiver, and thus increase the amplitude of its vibration. When we sing any particular note into a piano the strings of the piano emit only the same note that the voice sounded.

The vertical conductor is an essential feature of Mr. Marconi's system. It determines the distance to which signals can be transmitted. A conductor 20 feet high will signal well to a distance of a mile, 40 feet to 4 miles, 60 feet to 9 miles, 100 feet to 25 miles, and 120 feet to 36 miles. The height of the conductors used in the Boulogne experiment is 150 feet; those used between Alum Bay, in the Isle of Wight, and Poole, a distance of 18 miles, 80 feet high. The law as determined by experiment is this, that the distance increases as the product of two vertical conductors of different heights. This of course is the above law of the square when the lengths of the two conductors are alike.

The effects are distinctly best when signaling across the clear space covering the sea. The sea, like a sheet of metal, reflects these waves, but what does the irregular surface of the earth do? Mr. Marconi has obtained very satisfactory signals between positions which have been screened from each other by hills. French officers on board the "Ibis" at Sangatte, near Calais, on Monday succeeded in speaking to Wimereux, 20 miles away, over Cape Grisnez, a lofty promontory. We do not know at present much about the absorbing influence of the earth upon electric waves. There is room for experiment here. Indeed, the whole subject bristles with new fields for research. It is a misfortune that our physicists have done so little in this direction. Many of them seem to think that there is more importance in discovering priority of invention than in making an invention itself.

Mr. Marconi has been very busy in experimenting between the Isle of Wight and Bournemouth, and with moving ships in the Solent. He maintained communication between the Queen at Osborne House and the Prince of Wales on board the royal yacht "Osborne." The proceedings of the yachts in the Kingstown regatta of July last year were signaled from a following steamer, and regularly printed every evening in the Daily Express of Dublin. Lloyd's signaling station at Rathlin Island, in the north of Ireland, was placed in communication with Ballycastle. The two places are $7\frac{1}{2}$ miles apart. On the 27th of March communication was made through a distance of 30 miles between the South Foreland and Wimereux, near Boulogne. Communication has also been established and continuously maintained between the South Foreland, near Dover, and the East Goodwin lightship, a distance of 12 miles. There was a collision on Friday last between a steamship and this lightship during a thick fog. The fact was immediately communicated to the shore. Fortunately the damage was slight, but, of course, the most was made of such a stroke of luck. Although I had watched and assisted Mr. Marconi in his experiments from his first introduction to me in 1896, and the Postmaster-General had taken the greatest interest in the system, it was thought that independent experiments should be made to confirm our opinion of the practicability of the system. They were made in September, 1897, near Dover. Mr. Marconi's results were confirmed. I reported on the practicability of the system, and the Wireless Telegraph Company, who had secured Mr. Marconi's services and his inventions, were informed that they could connect Sark with Guernsey and the Post Office would open Sark as a public office. They were also informed that the Board of Trade and the Post Office, with the consent of the Trinity House, would be glad if they would connect the South Sand Head lightship with Dover. Neither of these extensions has yet been done. The company preferred to experiment elsewhere, as I have narrated, to prove what was not necessary to be proved, that it was possible to signal across the Straits of Dover, and to show that great distances could be connected. The result is that for nearly two years after its practicability was affirmed, not one single independent commercial circuit exists. The operations of the Wireless Telegraph Company are mysterious and inscrutable.

Captain Jackson, R. N., in December, 1895, commenced at Plymouth working in the same direction, and he succeeded in getting Morse signals through space before he knew anything of Marconi or his system. His reports to the Admiralty, however, were confidential. Had they been published, he would have anticipated Mr. Marconi.

When Mr. Marconi was showing the working at the South Foreland to the officials of the Post Office, he received a sharp shock. There was atmospheric electricity about, and Mr. Marconi repeated Franklin's experience. Sharp sparks were elicited from this miniature lightning, and at the same time erratic signals were observable at Boulogne. The speaking to Boulogne was not interfered with. The officers on board H. M. S. Vernon at Portsmouth one day observed similar disturbances, and obtained distinctly the letters A R E. Was this due to Mr. Marconi's experiments at the South Foreland, or was it due to atmospheric electricity? I think the latter, for I have frequently read letters, especially R, on Morse telegraphs when lightning was about.

There can be no question of the commercial value of the system for lightships, isolated lighthouses, shipping generally, and for naval and military purposes, but for commercial uses, such as telegraph communication with France, the system is at present nowhere. A single cable to France could transmit 2,500 words a minute without any difficulty. A single Marconi circuit could not transmit more than 20 words a minute. It is not wanted in this direction. Its name has led to the popular illusion that the poles and wires which disfigure our house-tops will disappear, but there is no evidence at present that a single wire can be dispensed with. It may add to our systems at work. It cannot diminish the number of circuits at work. There may be many outlying islands that can be connected to the mainland, but this can be equally effective by my own electromagnetic system. It must not be forgotten that this system of mine is in active practical use, and that its use can be largely extended. It is also open to all, and is not restricted by patent rights. It is, perhaps, unfortunately for me, not in the hands of an enterprising band of capitalists. If it were, it would not have been so soon forgotten. Wireless telegraphy is many years old. It is capable of great improvement, and if an electromagnetic receiver can be devised as sensitive as the coherer, it would work to equal distances, for the waves in each case extend precisely as far in the one case as in the other. Now we require parallel wires that extend to some distance on each side of a channel—a more sensitive magnetic receiver would reduce this to very short lengths. Other minds are at work on the subject.

I have not sufficient leisure to devote the requisite time to develop Ætheric Telegraphy, either on my own plan or on that of Mr. Marconi, but it has a potentiality of public use that is far beyond the dreams of newspaper writers.

Mr. Marconi is to be very sincerely congratulated on the success of his experiments. He has attracted the attention of the public to a very fascinating field of electrical development, and thereby has indirectly served the progress of scientific education.

* Paper read before the Society of Arts, London, May 3, 1899.

The corrosion of girders supporting the great Smithfield Market, in London, where the underground railways pass under the market, has reached such an extent as to call for radical repairs and reconstruction. There are three or four tracks, carrying an enormous traffic, the number of trains exceeding 60 per hour during the busy part of the day. Brick side walls supporting brick arches are being built effectively to protect the iron work from the gases from the locomotives, and the masonry will form a support of the new girders, etc., which will gradually replace those damaged by corrosion.

LIQUID AIR AND EXPLOSIVES.

By FREDERICK H. MCGAHIE.

A FASCINATING realm has been recently opened to science for exploration. It is governed by a magician whose delight is in paradoxes. With the touch of his wand substances appear to reverse those natures to which we are accustomed, for under the influence of liquid air, lead acquires a degree of elasticity, rubber becomes extremely brittle, roses grow friable petals, mercury is fashioned into hammers, and ice possesses a fiery heat. Our obligations to Charles Tripler are well known. His persevering work has taken liquid air from the list of expensive scientific curiosities and placed it at the service of all investigators. He has made it a commercial article, whose application to practical purposes will call forth the ingenuity of many minds. Of its value to pure science there can be no doubt. Its worth measured by the dollars of the commercial world lies with the future for verification. A magazine writer has credited Mr. Tripler with a claim that amounts to perpetual motion from a financial point of view. This claim is that a given amount of liquid air utilizing the heat of the atmosphere to change it into gas with expansive force can be worked in a suitable engine to produce a larger amount of liquid air, the surplus becoming available for production of power for manufacturing purposes. Free fuel would certainly revolutionize engineering practice. Engineers are always open to proof, but are meanwhile trusting to their yet unrevolutionized thermodynamic conceptions, and are designing and specifying costly boilers to set free the energy locked up in coal, for which article the "coal barons" are enterrifiedly demanding their stated amount of lawful currency. In Europe, some attention has been paid to the proposition of employing liquid air in explosives. It is reported that the German War Office is now prosecuting a series of experiments relative to its utility in that direction for military purposes. Our present knowledge of the matter points to but a limited degree of success. Theoretical considerations give a value to liquid air for explosive work that would appear to be balanced largely by the serious objections obtruding themselves persistently in practical tests.

A brief summary of the general phenomena of explosives will be of aid in viewing the theoretical side of the case. Chemical action occurring in a minute interval of time, and evolving considerable heat and a large volume of gas, underlies the explosive reaction. Heat is furnished by combustion and by the decomposition of endothermal bodies. The principal examples of combustion to be found in the study of the practical explosives are the formation of CO, CO_2, and H_2O. When the oxygen is furnished by the breaking up of NO_2, this action itself evolves heat to augment the heat furnished by combustion. The explosive reaction having been originated, the tendency is to produce the maximum amount of heat through the fullest oxidation possible to the system. One pound of carbon burning to CO_2 gives off approximately 14,500 heat units whose energy equivalent is 11,281,000 foot pounds; 1 pound of hydrogen in forming H_2O evolves some 62,000 heat units, representing 48,236,000 foot pounds. It is manifest that these reactions furnish plenty of energy for man to direct into the performance of useful work. They occur in the furnaces of boilers, but at a rate that removes such action far from the explosive one in which time is measured by the thousandth and the millionth of a second. On account of its volatility we may exclude liquid air from the gunpowder field, where a long time may elapse between the manufactory and the gun. It is among the high blasting explosives that the attempt is being made to introduce the substance. The characteristic of this class is detonation. In gunpowders combustion occurs progressively throughout the explosive, so that the pressure mounts from zero and allows mechanical action to occur along the lines of least resistance, and by physical details like intimacy of mixture, density, shape and size of grains, we are enabled to control the pressures developed to meet the various problems of gunnery. Detonation arises from a wave action propagating the explosion so rapidly through the mass that it may be considered instantaneous, the result being that the whole volume of highly heated and expansive gases is evolved in the original volume of the explosive itself, and the highest possible pressure of the system is thereby produced.

The result is a shattering blow that has little regard for the lines of least resistance. Detonation may be modified somewhat in the nature of its work in accordance with the practical limits of getting large blocks of material or crushing it into small fragments capable of being handled easily. It is probable that detonation may be provoked in any explosive by suitable means. In practice the gunpowders do not pass from their proper explosion to detonation through accidental causes, while the high explosives tend always to detonation if the original source of decomposition has not been sufficient to provoke it at the start. We may say, in the language of calculus, that gunpowders explode in *Δt*, and high explosives detonate in *dt*.

Consider 1 pound of carbon in the form of an impalpable dust distributed uniformly throughout sufficient air to insure complete combustion, the proper amount containing 2·666 pounds oxygen and 8·927 pounds nitrogen. Upon ignition of this mixture inclosed at atmospheric pressure in a strong vessel, the reaction would occupy but a minute fraction of a second and would be complete before any appreciable amount of heat could be transmitted to the walls. The resulting products would be 3·666 pounds of CO_2 and the original 8·927 pounds nitrogen. The explosion taking place at constant volume, the proper specific heat for the mixture of gases after explosion is 0·172, so that $0·172 \times 12·593 = 2·166$ heat units would raise its temperature 1° F. Since the action gives off 14,500 heat units, the total increase of temperature becomes approximately 6,700° F. The volume occupied by the carbon at the start is negligible in comparison with that of the air, so that the volumes before and after explosion are equal, the nitrogen remaining unchanged and the oxygen being replaced by an equal volume of CO_2. The theoretical pressure is due accordingly to the raising of a perfect gas at constant volume from the initial temperature taken as 32° F. to $6,700 + 32 = 6,732$° F. Pressures being under these conditions proportional to the absolute temperatures, we obtain the figure of 14·6 atmospheres absolute. The coal dust explosions that do occur are more dangerous for carrying flame than for destructive effects, since the supposition of an impalpable dust suspended uniformly in the proper amount of air is not at all realized and the combustion occurs slowly enough to permit expansion of the gases before any appreciable pressure is produced. The light combustible dusts guarded against in flour mills and grain elevators give a better approximation to the conditions. It is well known that such explosions wreck buildings in addition to igniting combustible material.

In the above example the nitrogen is a drawback in occupying space and absorbing heat. Considering it removed, the 14,500 heat units are available for increasing wholly the temperature and pressure of the 3·666 pounds of CO_2. At constant volume the increase of temperature is 23,000° F. and the pressure becomes 47·8 atms. absolute. To employ this case in practice we would have to select some combustible gas to add to the oxygen in order to attain a homogeneous mixture. Many of the hydrocarbons would do. Marsh gas may be selected as representing the chief ingredient in mine gas explosions. With pure oxygen

$$CH_4 + 2O_2 = CO_2 + 2H_2O.$$

One pound CH_4 contains 0·75 pound carbon and 0·25 pound hydrogen. The complete oxidation of these gives 26,375 heat units. To break up the pound of CH_4 about 2,100 heat units are required, and to raise the 2¼ pounds of water from 32° F. to steam at 212° (to have our products all gaseous at atmospheric pressure in the calculations) 2,580 units are needed. This leaves about 21,700 units available for producing pressure, which figures out as 34·3 atms. absolute or 490 pounds gage. Such pressures are, however, of no value for explosive work. The first idea would be to compress the mixture heavily, so that the multiplication of the initial pressure would take us into the region of high pressures. The difficulties, cumbersomeness, expense, and limitations of such a system are apparent. But there are supplies of highly condensed oxygen in many salts, and the practical explosives consist of intimate mechanical mixtures, like black powder, of a combustible and an oxygen-bearing salt, and the explosive compounds, like nitroglycerin, in which combustible and comburent exist side by side in the same molecule. Thus 1 pound of nitroglycerin occupying but 17·3 cubic inches contains by weight 0·158 carbon, 0·022 hydrogen, 0·185 nitrogen, and 0·634 oxygen, and, when exploded in its own volume, has a theoretical pressure of over 30,000 atmospheres. It is to be noted that these theoretical pressures run considerably above measured ones, since specific heats are increasing functions of the temperature and chemical dissociation limits the reactions and temperature attainable to the vicinity of that temperature at which the completely oxidized products cannot exist. Such calculations are, however, of value in indicating the relative effects of which various explosives are capable.

It is as a source of highly condensed oxygen that liquid air enters into the case. The lower boiling point of liquid nitrogen permits the concentration without material loss of liquid air to a point at which it contains 75 per cent. by weight of oxygen wholly available for explosive purposes. Nitrate of potash has but 39 per cent. of available oxygen and sodium nitrate 47 per cent. It is better than nitroglycerin with its 63 per cent. In addition the nitrogen, in passing from the liquid to the gaseous state, increases the volume of gaseous products and adds thereby to the pressure, compensating in a degree for the heat absorbed by it. This highly oxygenated liquid has a density about that of water and yields a powerful explosive upon admixture with some combustible material permitting it to soak in well. Those who have witnessed Mr. Tripler's experiments have seen sponges, felt, cotton, and such bodies dipped into liquid air flash off upon ignition like so much loose guncotton. When slightly confined, a proper primer will produce detonative action similar to that of the dynamites. Indeed, the broken tube pictured in illustration 17 of Prof. Peckham's article contained in the April 29, 1899, SCIENTIFIC AMERICAN SUPPLEMENT exhibits most violent effects obtainable upon simple ignition in an open tube of a wad of cotton saturated with liquid air. This makes the process of manufacture a simple, safe, and cheap system. Into a prepared cartridge, containing some combustible like pulverized coke or some weak nitro-compound arranged to allow rapid saturation, the oxygenated fluid is poured. One trouble would appear at least at this stage. Liquid air produces a most serious burn that heals very slowly. Workmen who can blow themselves up with dynamites with more or less frequency will give many opportunities for studying such burns.

Its volatility is a decidedly bad, if not fatal, feature. The present practice is to place the liquid air in tin cans packed in felt. Such a can holding 3 gallons has taken 10 hours for complete evaporation. Prof. Dewar has brought forward a double-walled glass receptacle in which a vacuum is formed between the walls. This device multiplies the figures of felt-protected cans five or six times. But in case of delivery from a central station, and on the assumption that practical cans based upon Prof. Dewar's idea are feasible, the consignee would naturally expect to have something outside of a can delivered to him, and the above figures must be materially reduced. Most places where any amount of blasting explosives is used are located in out-of-the-way places. Transportation by freight is out of the way, and express service is a prohibited luxury. Even assuming it could be delivered commercially, liquid air would have to be used up within a few days at the outmost, and no contractor would even consider the proposition of being dependent several times a week upon the timely delivery of explosive material. The only way out of the matter is to install a plant on the spot to deliver liquid air as needed. This limits our case to contracts of some degree of magnitude. In extensive blasting the economical policy is to fire many holes at the same time. No protecting envelope that would be of value is permissible for the charge, since enlarged bore holes represent increased expense, and it is necessary that the charge should be packed in closely. The tamps would not stay in long under the pressure of the evaporating oxygen. What would occur would be that by the time the holes had been loaded, the wires connected up, and the men removed to a safe place, there would be no oxygen left in the charges. Some European tests have found little value in the commercial utilization of liquid air for explosive work. I quote from London Engineering: "The process has been tried experimentally, but on a commercial scale, at the Penzberg coal mine near Munich. The powdered carbon mixed with one-third its weight cotton wool is placed in a cartridge case of stiff paper and the liquid air poured over it. The mixture maintains its full explosive properties for 5 to 10 minutes, but after that falls off in power, and at the end of 15 to 30 minutes loses all its explosive properties." The liquid air was supplied by the European investigator, Dr. Linde, from his apparatus for liquefying air and contained around 50 per cent. oxygen. The effects of the fresh explosive were very powerful and comparable to those of dynamites.

PHOTOGRAPHING BACTERIA.*

By EDMUND J. SPITTA.

BACTERIA in their natural unstained state are exceedingly small, and for the most part colorless and structureless bodies of protoplasmoidal matter assuming all manner of shapes and having such a high refractive index as to be most difficult to see—even with a magnification of 1,000 diameters—and still more difficult to photograph. Although these little organisms can be artificially stained by solutions of many substances, still each variety seems to have a more or less well marked selective power of absorbing the coloring matter of one or two special dyes in preference to that of any other. Hence, as the photo-micrographer meets with this type of work he must expect not only all varieties of shape, but all varieties of color also.

The difficulty noticed by all photographers in obtaining a well-contrasted print of these little bodies depends solely upon the fact that the dyes with which the organisms are stained do not affect the photographic plate in the same manner and to the same extent as they do the eye. For example, a slide may be a very excellent one from a bacteriological point of view, and owing to the selective coloring of the organism as compared with that of the background, may be of a most impressive nature, yet it will not yield an equally contrasted print. On consideration, the reason for this apparent anomaly is not far to seek. Contrast visually was obtained by differentiation of color rendering between the bacillus and the background, whereas in the photograph it must depend upon what effect each color can cause on the plate. Put another way, contrast visually is due to duality of color rendering, whereas in the print it alone depends upon what amount of differentiation in terms of black and white the colors employed as stains have been able chemically to produce—by deposition of silver—in the emulsion which covers the plate.

The aim of the operator must be to increase the difference in these deposit ratios as far as he possibly can. To understand how this can be effected, the attention of the reader must be directed to the following:

1. Color sensation to the eye is dependent upon the wave length of the light employed. The longest wave gives rise to the red sensation, and the shortest to the violet; intermediate lengths being productive of sensations we call yellow, yellow-green, green, greenish blue, blue and blue-violet.

2. The ordinary photograph is taken by the violet ray, because the usual emulsion is most sensitive to that particular wave length. Plates, however, can be stained so as to be extra sensitive in any one or more colors, but even then with this extra sensitiveness, the action of the violet is always the strongest, i. e., more precipitation of silver—time for time—is produced with violet light than any other color.

3. Ordinary white light consists of a blending in certain proportions of lights of all wave lengths.

4. An ideally perfect monochromatic screen is one that intercepts all other wave lengths save the one it passes. A red screen, therefore, cuts off (really converts into heat) all other rays, save the red ones; blue cuts off all but the blue, and so on. It is difficult to obtain a really monochromatic screen, and impossible to obtain a glass ideally perfect, save perhaps in the case of red glass. It must also be noted that perfection of monochromatism also depends on the strength of the illuminant, that is to say, a screen may be almost perfect with a weak light, but far from perfect with a strong one.

5. The effect of placing two monochromatic screens each ideally perfect, and of the same intensity, over one another would be to cause blackness, such blackness being the more perfect the more intense the screens or the feebler the white light—screens of differing intensity vary in their effect according to such variation, by which is meant an intense red and a feeble green will allow a residuum of red; a strong green and a thin red, a residuum of green, and so on.

6. As ideally perfect monochromatic screens are obtainable with such difficulty, so with ordinary ones another residuum may be left. Red filters often pass a little yellow; blue ones often a little red; green ones occasionally a little blue, and often red; while yellow ones are rarely pure at all, permitting red and green rays to pass to some considerable amount. If, now, a blue passing red be placed over a good green, but one passing a modicum of red, and provided the light be intense enough, a dark, deep red residuum is noticed instead of blackness. This is obviously caused by the green and violet causing darkness, but not sufficient to annihilate the reds from each glass. More green or more violet will often effect the production of complete darkness. In practice, owing, of course, to impurities, it is found that some colors are more antithetical than others. Red and green, for example, usually produce greater blackness than red and orange, a fact which we shall presently explain is made use of at times.

Now with these six precepts before us I hope to be able to show how the photographer can increase the contrast in his negative, and so, of course, in the print which is taken from it. Let it be assumed that he has taken an ordinary photograph of a red bacillus on a white ground, with blue-stained nuclei of cells interspersed about. He finds a flat result, a negative that produces a wretchedly poor print lacking all contrast. Now let him place a fairly strong green screen over the illuminant and use a green-stained plate to shorten exposure. The resulting negative will show clear patches

* From an article on Photo-micrography in The Pharmaceutical Journal.

of glass corresponding to the red bacilli, a fairly clear deposit for the blue nuclei and an intensely black one for the background. If the bacilli are too clear, so much so that any little alteration of structure, such as segregation, seems lost, then let him use a fainter green or employ a brighter light, and the result may be good. If still not satisfactory let him try an orange screen, for as that color is not so antithetical as green is to red, it will allow a little more light to pass. The resulting print will give of course a black bacillus, a well-defined appearance of the scattered nuclei, while both bodies are seen lying on a clear white background. The whole picture is full of contrast and pluck.

As a matter of fact, pure monochromatic screens for photomicrographing bacteria are not required; good pot glasses are amply sufficient, for be it understood it is only increase of contrast that is required, and not entire annihilation of structural details, or the rendering of minute lines visible, as in the case of diatoms. To be practical, then, in photographing bacteria, glasses of all colors must be procured, and also it is convenient to get several shades and several densities. For what may give rise to sufficient contrast to the eye with the ordinary lamp may not be sufficient, or, on the other hand, which is much more frequent, may be too great, when the photograph is taken. It would have been thought the intense lime-light should always demand still greater thickness of color, but it is usually just the reverse, for the light is reduced considerably, as seen on the ground-glass screen, when compared with that visually viewed at the eye end. The very fact that a virtual image is seen by the eye and an actual image viewed on the plate entails a loss of initial light, as the rays have to again cross. This crossing is obvious, as the image is upside down to the eye, but the right way up on the plate in the camera.

Screens may be used to increase definition when taking photographs of fine lines in diatoms, and the best method is to make these by mixing anilin and other colors with a specially made collodion, formed by dissolving pure celloidine in equal parts of ether and alcohol. Float the collodion over very thin glass plates—cover-glass type of glass preferable, especially flat ones—allow to dry, and cover with another protective glass, as when covering ordinary lantern slides. Malachite green, methyl green, blue and violet anilin, fuchsin, naphthol yellow, chrysoidin, all of differing quantities and densities, may be made; they may be of service. There is no special difficulty otherwise than to obtain sufficient contrast in taking photo-micrographs of bacteria when they are stained. Hydroquinone produces dense pictures which are always necessary, especially when lantern slides are required, for no background, unless it be of some specific nature, is needed, and the bacteria on clear glass look much better on the screen than when they are shown on dirty white background.

When taking a photograph of living bacteria, such as the clumping of the typhoid germs in Widal's method of diagnosis, much difficulty may be experienced in getting a photograph at all. It is best then to take advantage of diffraction effects and to close the iris, which would be otherwise considered an undue amount. By this means a faint "standing-out" effect is produced which enables the bacteria to show sufficiently for the purpose, provided the exposure be short enough to prevent choking effects, and yet long enough to give a sufficiently dense background. I have found about ten seconds sufficient with a subdued light and using a 1-6 inch apochromatic objective. A vertical apparatus must be used. It should be distinctly remembered that when photographing bacteria at any time the iris diaphragm should never be closed, and a full-sized cone of light always employed; otherwise white diffraction lines will appear around the organisms. At times I have thought that a 1·35 sub-stage condenser gave better results, especially when photographing bacteria with flagella.

APPARATUS FOR STOPPING SHIPS.

THE agent of the Austrian Lloyd Steam Navigation Company, in Venice, has brought to my notice an interesting series of experiments recently conducted at Fiume by the director of the Lloyd shipyards. The experiments tested the efficiency of an invention by a Hungarian engineer, Mr. Svetkovich, for stopping vessels under full steam. The Austrian Lloyd placed its towboat "Clotilde" at the disposal of the inventor, and three trials were made to test the invention under different conditions.

This marine brake is a sort of parachute of fine spring steel plates which, when out of use, fit into one another and hang above water.

For the first trial, the apparatus was attached to the stern of the "Clotilde," and the steamer put on full steam. When maximum speed was attained—in Austrian reckoning, 9 miles per hour—the retaining hook was released, and the parachute plunged into the water. With a scarcely perceptible shock the vessel came to a standstill in 30 feet. It was found, however, that the rods and guys supporting the brake were badly strained. If they had not yielded, the shock would have been much more severe. The fact that the supports did yield did not argue seriously against the efficacy of the brake, but was attributed to the provisional character of the arrangements.

The second trial was designed to show how far the vessel would proceed when her engines were stopped at full speed, no brake being used. The distance was found to be 300 yards.

The third trial measured the forward movement when the engines were reversed from full speed ahead to full speed astern. This time the "Clotilde" stopped in 60 yards.

While the second and third trials were in progress, the marine brake was refitted with more powerful supports, and a fresh experiment was made. This time the vessel stopped almost instantly.

These results, while hardly to be considered valid for the powerful ocean liners, with which the necessity for a quick stop is occasionally so crucial, indicate that an important principle has been introduced among marine safeguards. The Austrian Lloyd Company is awaiting with interest the results of an improvement which Mr. Svetkovich wishes to add to his device, and seriously contemplates equipping its great fleet with the useful apparatus. H. ABERT JOHNSON,

Venice, January 14, 1899. Consul.

THE

Scientific American Supplement.

PUBLISHED WEEKLY.

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